ANNUAL Pipe-Line NUMBER

L AND GAS URNAL

Old Hands on New Jobs

Bechtel forces are under way on new and big pipe line developments at home and overseas. Keeping "assembly lines" on the march across hundreds of miles of remote country presents tough problems in logistics.

But the work moves ahead steadily. There is nothing short of experience to match any difficulty that new conditions impose.

BUILDERS FOR INDUSTRY
BECHTEL

BECHTEL CORPORATION LOS ANGELES · SAN FRANCISCO · NEW YORK

ECONOMIC STUDIES · PROCESS DESIGN · ENGINEERING · PURCHASING · CONSTRUCTION

PRICE 50 CENTS

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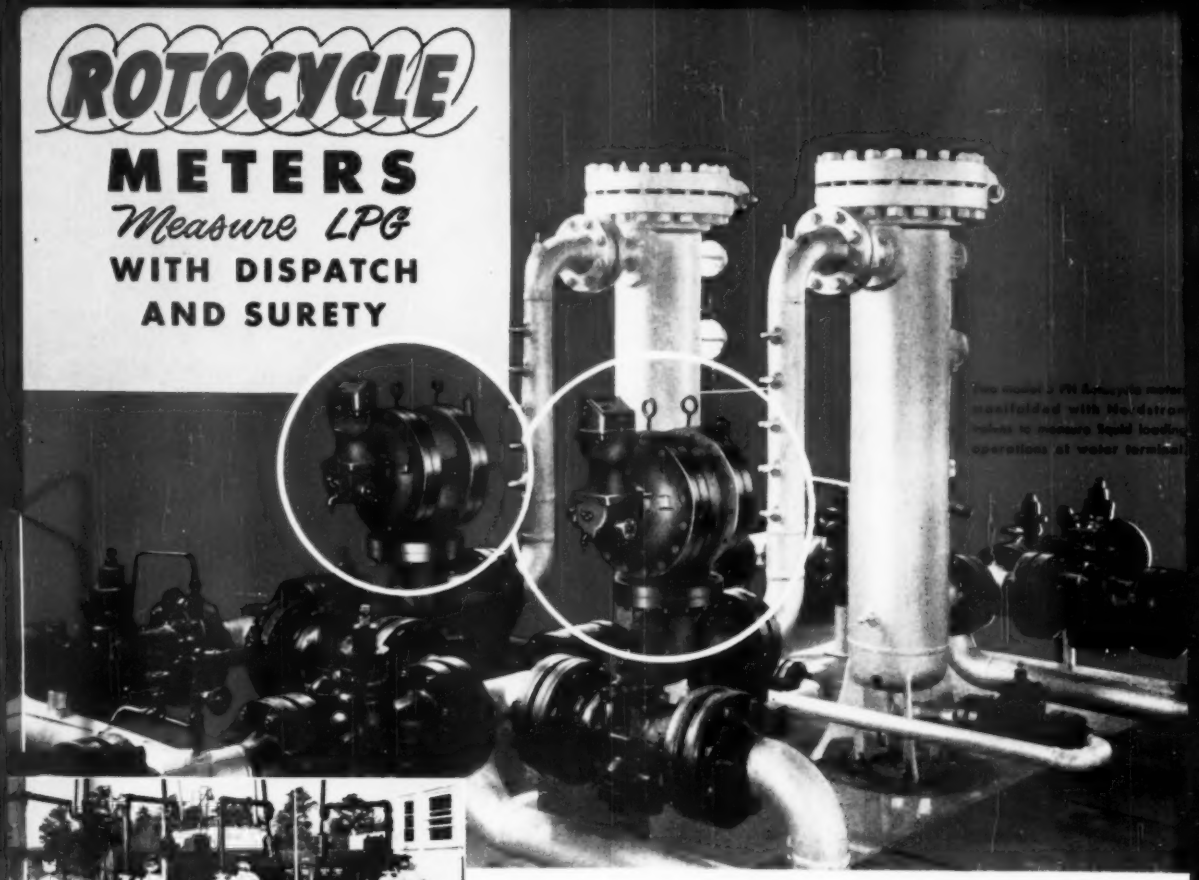
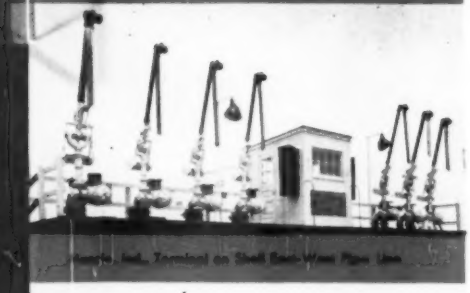
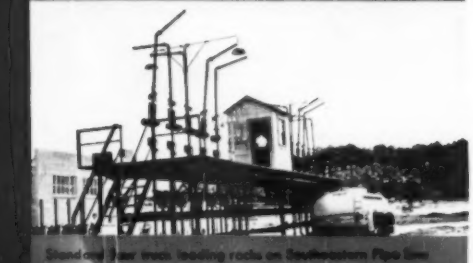
OCTOBER 6, 1949

ROTOCYCLE METERS

Measure LPG WITH DISPATCH AND SURETY





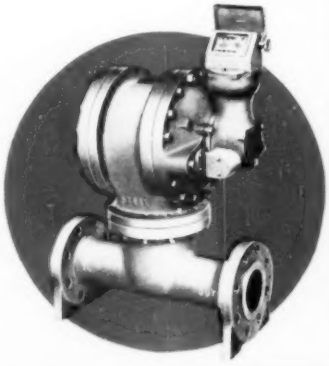


Whether it's finished products or crude oil, Rotocycle meters accurately control measurement

Rotocycle meters now guard the input and dispersal points of many leading crude and finished product pipe lines. They accurately count the barrels as they roll through the line. They put a stop to "guesstimating" this throughput. And they protect pipeliner's profits.

Rotocycle meters are engineered and built to stand up under the toughest operating conditions. They are made in four sizes for either high or low pressure service and may be fitted with a variety of registers to suit any field requirement. Write for bulletins and case histories of actual operating experience.

Rotocycle meters thrive on hard work. In this design there are no valves or pistons to wear and cause inaccuracies. Too, the all-revolving mechanism, with its ball-bearing mounting offers minimum restriction to line flow. Generous size interior passageways are provided. Operation is quiet and without pulsation.



PITTSBURGH EQUITABLE METER DIVISION
Rockwell Manufacturing Company
Pittsburgh 8, Pa.

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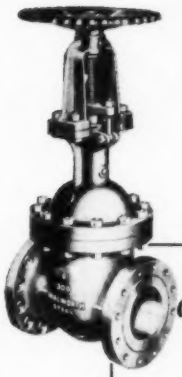
WALWORTH

Cast Steel Gate Valves

Series 150 and 300

Wedge Gate — Outside Screw and Yoke



Sectional view of Series 300

Big 8-Point Superiority!

Gland clearances are such that stem cannot be scored if gland should be tightened unevenly.

Deep Stuffing Boxes in all sizes (2″ to 24″) insure tightness and maximum packing life – costly leaks are eliminated.

Bonnets and Bodies are engineered to withstand pressure and minimize distortion – they're tough, durable, dependable.

Heavy Steel Walls provide extra strength and longer life.

Integral Body Guide Rib Faces are machined to insure accurate disc seating.

Seat Rings are bottom seated – not flange type. No recess exists at back of ring – hence no turbulence, erosion, or pressure drop.

Streamlined Ports allow high velocity, non-turbulent flow, and reduce the possibility of erosion.

Valves regularly have flanged ends. They can be supplied with ends for butt welding. Roller bearing yokes are available. On valves 5 inches and larger, by-passes can be furnished.

For Series 600 and higher, we recommend Walworth Pressure-Seal Steel Gate Valves.

For further information on Walworth Cast Steel Gate Valves, see your local Walworth distributor, or write:

WALWORTH

valves and fittings

60 EAST 42nd STREET, NEW YORK 17, N. Y.

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Fairbanks-Morse QZK Motors on your pumping rigs mean protected power. Falling particles, dripping liquids can't hurt this motor. Its one-piece cast frame of unique design completely protects the motor in any position. This positive protection and other great features . . . the exclusive indestructible copperspun rotor . . . efficient cross-flow ventilation . . . cartridge type ball bearing mountings . . . and measured lubrication are your assurance of better pumping performance. Fairbanks, Morse & Co., Chicago 5, Ill.

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For help with your problems, write our Technical Staff. Ask also for our authoritative booklet "Evaluating the Forgeability of Steels". The Timken Roller Bearing Company, Steel and Tube Division, Canton 6, Ohio. Cable address: "TIMROSCO".

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Specialists in alloy steel—including hot rolled and cold finished alloy steel bars—a complete range of stainless, graphitic and standard tool analyses—and alloy and stainless seamless steel tubing

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Buy AMERICAN

American Pumping Units are available in a full range of sizes from 5,000 to 27,000 lbs. Polish Rod load with 18,000 to 228,000 inch lbs. Peak Torque Reducer. You can get the size American Unit you need for more efficient pumping on any well.

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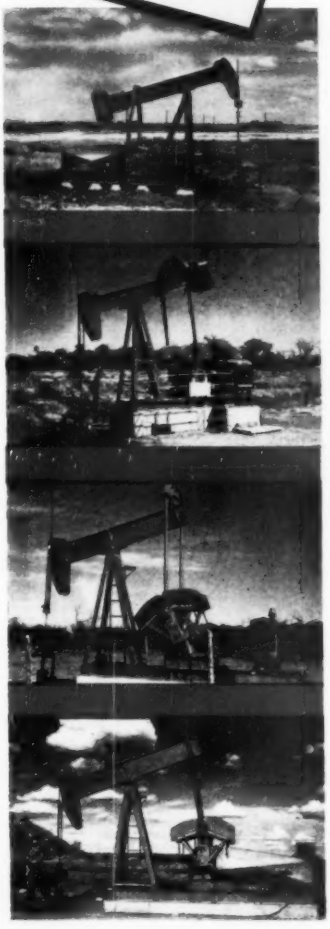
Contact your favorite supply store or nearest American Office NOW. **IMMEDIATE DELIVERY.**



25th Year

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Export Office:
500 Fifth Ave., New York, N. Y.

AMERICAN MANUFACTURING COMPANY OF TEXAS
FORT WORTH, TEXAS PHONE 8-2301

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DriCoolers are the only finned tube cooling units that have mechanical equipment proved in over 5,000 actual installations.

Fans, driveshafts, Geareducers and fan cylinders long used successfully on the toughest air moving job—water cooling towers—have been further improved and tailored for the DriCooler.

This new mechanical equipment with the "Made-by-Marley" label is your guarantee of "stout-hearted" air-cooled units.

Induced Draft horizontal heat transfer surface under the fan.

*DriCooler is the exclusive trade-mark of The Marley Co., Inc.

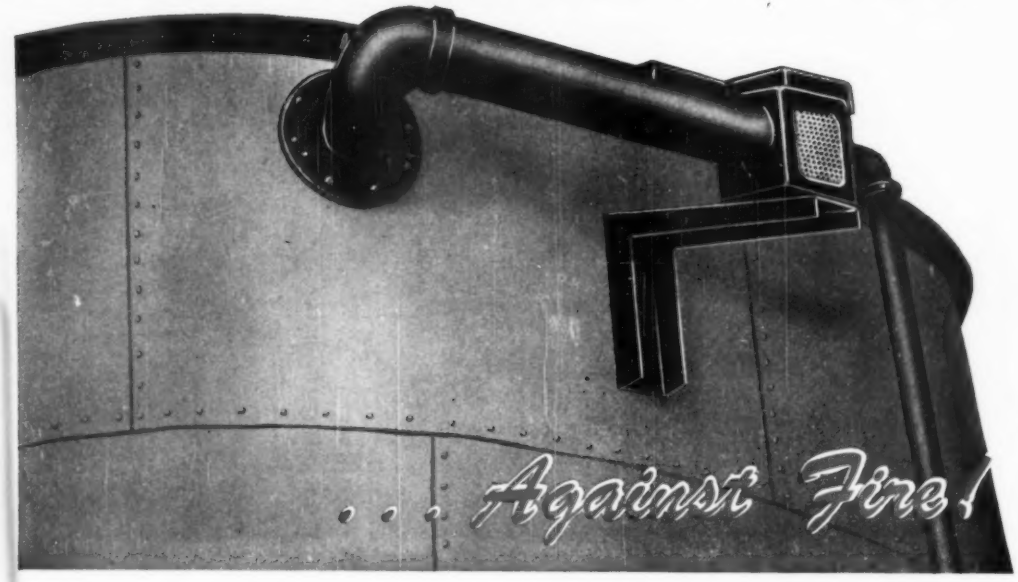
Forced Draft horizontal heat transfer surface over the fan.

MARLEY DRICOOLERS

THE MARLEY COMPANY, INC. • KANSAS CITY 15, KANSAS

WATER COOLING TOWERS • DRICOOLERS • SPRAY NOZZLES

SECURITY...



WITH THE FOAMITE AIRFOAM SYSTEM

Flammable liquid tanks are secure against fire when adequately protected by a correct installation of the Foamite Airfoam System. Each System is specially engineered by Alfco experts to suit the individual needs of a particular risk. The Foamite Airfoam System supplies tenacious, long-lasting, blaze-smothering Foamite Airfoam in ample quantities for quick, complete extinguishment.

The System may be connected to protect more than one risk. It is scientifically designed for the correct mixing of Foamite Airfoam Liquid, water, and air, to produce ten gallons of Foamite Airfoam for each gallon of 6% Foamite Airfoam Solution. Solutions are mixed by either of two types of proportioners — the Foamite Airfoam In-Line Proportioner for tanks not requiring extensive piping, and the Around-the-Pump Proportioner for use where long supply lines involve pressure losses. The Foamite Trough for fixed Systems, and Foamite Airfoam Applicators for portable use, facilitate foam delivery, insure flexibility of Foamite Airfoam System arrangements.

Another valuable portable Foamite Airfoam unit is the Foamite Airfoam-Generating Nozzle, which creates Airfoam by drawing Foamite Airfoam Liquid from a pick-up tube, mixing it with water to the necessary 6% Foamite Airfoam Solution, and agitating it with air. All Foamite Airfoam devices approved by Underwriters' Laboratories, Inc. Write for free 24-page booklet of engineering data.

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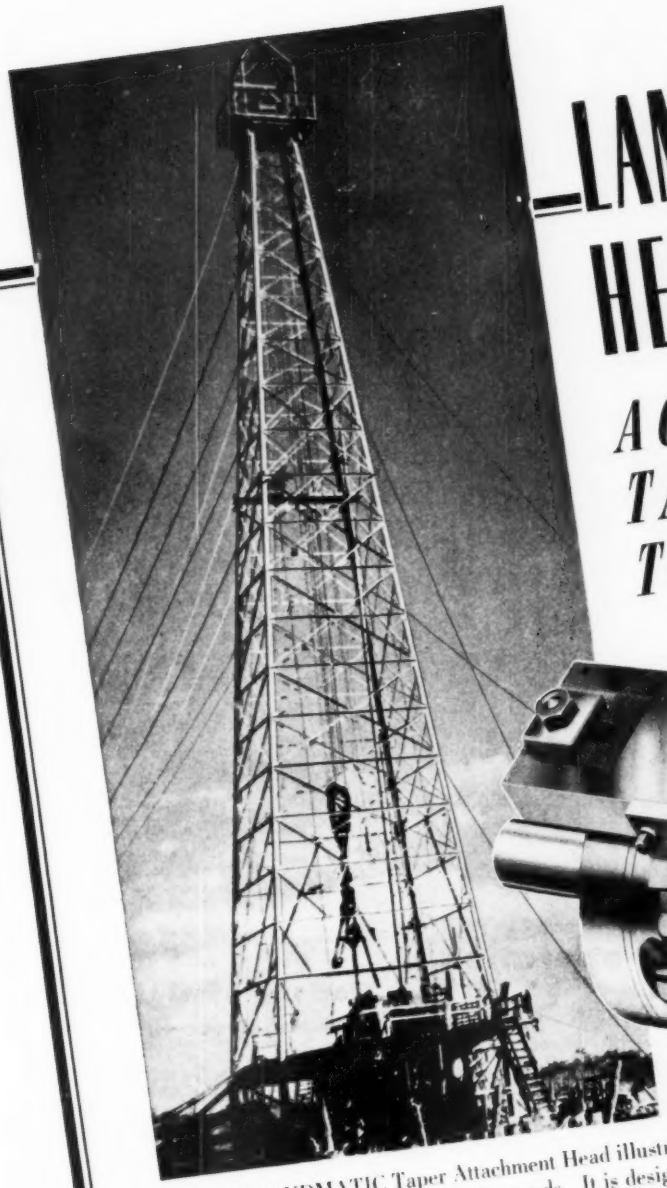
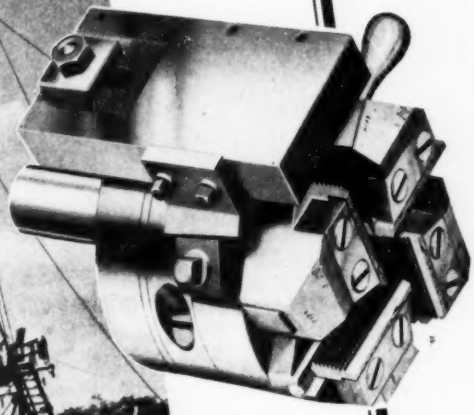
ALFCO

LANDMATIC HEADS for ACCURATE TAPERED THREADS





● The 2" LANDMATIC Taper Attachment Head illustrated is widely used in the production of oil tubular goods. It is designed primarily to cut taper threads to exacting A.P.I. standards. The Taper Attachment by limiting cutting action to the throat section of the chaser reduces chaser wear and increases thread accuracy. *Write for Bulletin F-90.*

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Represented in the Domestic Oil Fields by: Concord-Wright Machinery & Supply Co., St. Louis, Mo.; C. J. Harter Machinery, Houston, Texas; Frederic-Baker Co., New Orleans, La.; Moore Machinery Co., Los Angeles and San Francisco, Calif.; Hendrie & Bolthoff Mfg. & Supply Co., Denver, Colo.

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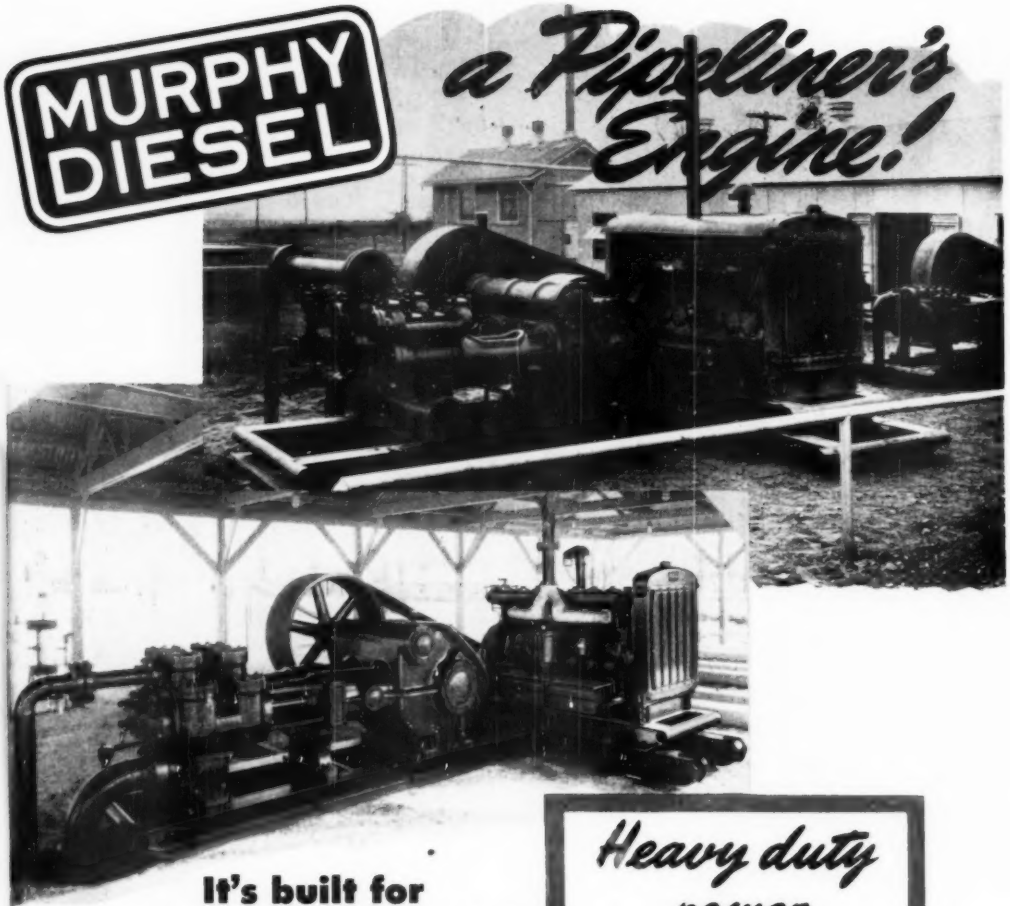
a Pipeliner's Engine!



It's built for 'round-the-clock operation

Economy and dependability — that's the combination that makes Murphy Diesel the answer to a pipeliner's needs. With unit fuel injection and "true" diesel operation — solid fuel injected directly into a plain, open combustion chamber — the Murphy Diesel uses less fuel per horsepower hour than *any* other diesel of comparable power rating. Dependability is assured by quality workmanship and an exclusive combination of design features such as... four valves per cylinder... extra large crankshafts and bearing surfaces... hydraulic servo-type governor... through steel tie bolts... oil cooled pistons... dual overhead camshafts ...and many others.

Heavy duty power

for the oilfields

Murphy Diesel Engines and Power Units for pipeline pumping and drilling, 90 to 220 H.P. Diesel-Electric generating Sets 60 to 135 K.W. Diesel, Dual-Fuel, Crude Oil.

Before you buy your next diesel for pipeline pumping service be sure and look into the advantages of Murphy Diesel Power. Ask your Murphy Diesel Dealer for full details or write direct.

MURPHY DIESEL COMPANY

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- Two of four 96,000 barrel (120' x 48') welded steel tanks for Pontiac Refining Company, Corpus Christi, Texas.

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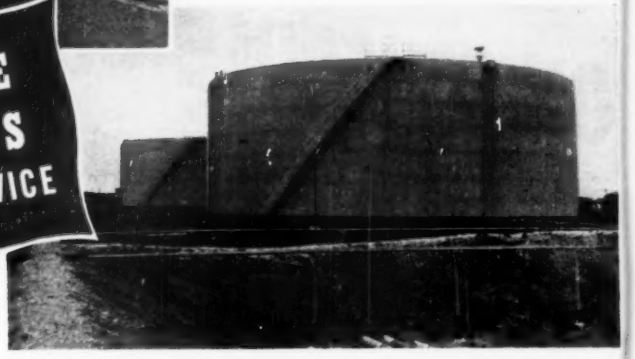
TANK ERECTION SERVICE



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ADDS THE FINISHING TOUCH TO EVERY ELLERBEE JOB

These three jobs are typical of the tank erection service Ellerbee Brothers offer the oil industry.

We furnish and erect all sizes of storage tanks . . . welded or riveted, steel and aluminum. We repair, dismantle, move and re-erect riveted and welded storage tanks, refinery equipment and pipe installations. We fabricate and erect industrial piping, steel and aluminum.

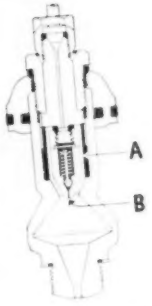
In addition, we give *your* job personal supervision during the entire period of construction. That's the finishing touch that our organization gives every job because we are small, yet experienced enough and large enough to undertake any size job. We will appreciate an inquiry on your piping and tank erection problems.

ELLERBEE BROTHERS
P. O. BOX 857 PORT ARTHUR, TEXAS

LAYING IN ON SCHEDULE IN TOUGH GOING

HI-EFFICIENCY FUEL INJECTION VALVE

Typical of the quality built into "Caterpillar" Diesel Tractors are the fuel injection valves. Capsule (A) is easily removable for unit replacement in the field. No adjustments are necessary. Single orifice opening at (B) prevents clogging and maintains desirable fuel spray characteristics at all times. Countless "Caterpillar" Engines have operated many thousands of hours without capsule replacements.



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Box OG-10, Peoria, Ill.
Send me, without obligation, your pipe-line booklet: "It's 'Caterpillar' All the Way."

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Address _____

City _____

State _____

WATER, gas and sewer lines cross this 24" offshoot section of the "Biggest Inch" natural gas line at frequent intervals in San Gabriel, Cal. That makes the going tough—and that's why "Caterpillar" gets the call from Alex Robertson Co., Clearwater. This outfit uses two 65 drawbar horsepower "Caterpillar" Diesel D6 Tractors with Trackson Pipe Layers to stab and lay in the 4-ton pipe sections. These big yellow machines have the weight and balance to work well back from the ditch and still give "sharpshooter" spotting of heavy pipe. And that means laying in on schedule.

Wherever the pipe-line right of way may lead, you can depend on "Caterpillar" Diesel power for superior performance. And with hundreds of well-equipped "Caterpillar" dealers in the U. S. and Canada, you're always sure of expert, on-the-spot service to keep your equipment moving for money-making production.

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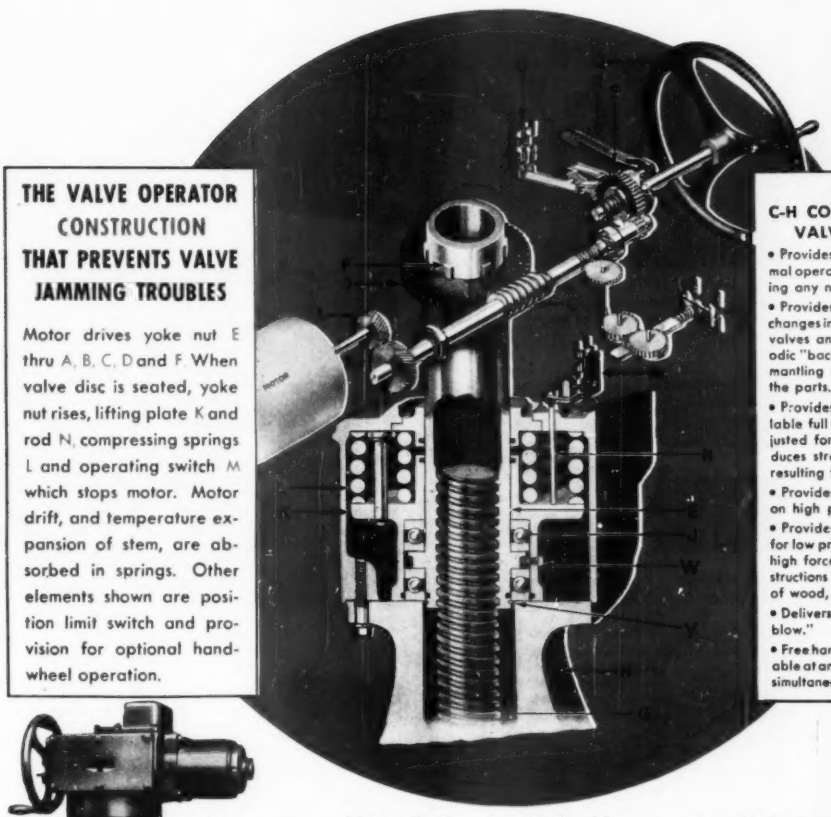
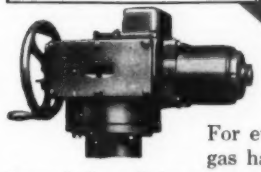
BETTER...SAFER...SURER
VALVE OPERATION
FOR EVERY PETROLEUM INDUSTRY NEED

THE VALVE OPERATOR CONSTRUCTION THAT PREVENTS VALVE JAMMING TROUBLES

Motor drives yoke nut E thru A, B, C, D and F. When valve disc is seated, yoke nut rises, lifting plate K and rod N, compressing springs L and operating switch M which stops motor. Motor drift, and temperature expansion of stem, are absorbed in springs. Other elements shown are position limit switch and provision for optional hand-wheel operation.





Features of
C-H CONTROLLED THRUST VALVE OPERATORS

- Provides tight closure under normal operating conditions, eliminating any need for "final" seating.
- Provides for large temperature changes in high temperature steam valves and gas valves. No periodic "back off" necessary. No dismantling of valve to "unfreeze" the parts.
- Provides for accurately controllable full power drive, easily adjusted for service conditions. Reduces strain and wear and tear resulting from other systems.
- Provides high speed operation on high pressure valves as well.
- Provides ADEQUATE Protection for low pressure valves... against high forces, against artificial obstructions such as gravel, a piece of wood, etc., in the valve.
- Delivers an unseating "hammer blow."
- Free hand-wheel operation available at any time. Protected against simultaneous electrical operation.

For every problem of oil and gas handling from production through the refining processes and out across the pipe line networks, the *controlled thrust* principle of Cutler-Hammer Motorized Valve Operators gives these definite advantages for all kinds of valves:

It *always* assures a tightly seated valve regardless of the frictional condition of the valve stem or the driving mechanism.

It *definitely* prevents damage to a valve from the expansion and contraction of valve parts under extremes of temperature.

It *unfailingly* provides correct seating no matter how swiftly the valve is closed, and it prevents damage in case foreign matter lodges in the valve.

Cutler-Hammer *controlled thrust* Valve Operators gain their superiority through what may be called a transferable fulcrum. They drive through a yoke nut fulcrum established by heavy steel springs whose compression is equal to the desired tight seating pressure. When the valve is accurately seated, the *seat* becomes the fulcrum, the yoke nut retracts, opening the motor circuit, and motor drift is absorbed by the springs. Moreover, the same accurate seating is maintained as valve parts expand and contract.

Now is the time to investigate this proven superior motorized valve operator for your needs. Available as standard equipment on all leading makes of valves..... CUTLER-HAMMER, Inc., 1453 St. Paul Ave., Milwaukee 1, Wis.

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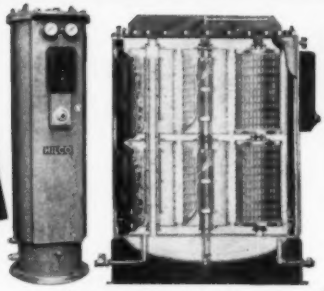
VALVE CONTROL
C-H

There's a HILCO that will best fit into your Lubricating and Fuel Oil Filtering Plans . . .

HILCO HYFLOW OIL FILTERS "S" SERIES

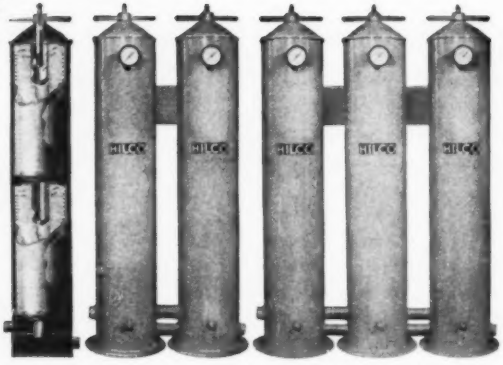


HILCO HYFLOW OIL FILTERS "R" SERIES SPACE SAVERS

● For lubricating oil or storage to engine fuel oil filtering using 5" x 11" and 7¼" x 18" Filter elements. Easy and quick to service.

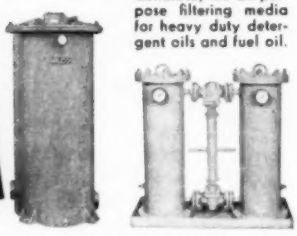
● For lube oil using one or a multiple of 11" x 18" Filter cartridges easily handled by the operator, offering large filter area and proper depth to assure complete saturation of filter material. Available with and without heaters.

*Both are interchangeable at any time.



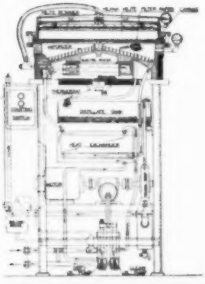
● Hilco Hyflow Oil Filters use Hilite-Fuller's Earth for filtering straight mineral and fuel oil or Hiltex-Cellulose, the all-purpose filtering media for heavy duty detergent oils and fuel oil.

HILCO HYFLOW OIL FILTERS "C" SERIES



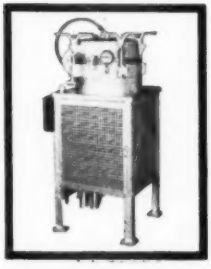
● For Lube and Bulk Fuel using one or a multiple of 7¼" x 18" Filter cartridges offering the maximum in filter area and correct depth for high flow rates and efficient filtration. Available in simplex type with or without heaters, duplex without heaters.

HILCO OIL RECLAIMERS



● For direct connecting to one or more engines for perfect and complete lube oil purification—removing carbon sludge, abrasives, tarry matter, and acids, water and fuel dilution—and color restoration.

Hilite-Fuller's Earth for filtering straight mineral oils—ADSTAY DISCS for heavy duty detergent oils.



CLEAN OIL MEANS CLEAN ENGINES LOWER MAINTENANCE COSTS . . . .

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ISOLATE ANY SECTION OF A TRANSMISSION LINE

WITH MUELLER LINE STOPPERS AND EQUIPMENT

H-17255 Welding Fitting as Furnished with Cast Iron Plug and Completion Cap.

C-1 Power Operated Drilling Machine Attached to Gate Valve on the Welding Fitting.

H-17235 Stopping Machine with By-Pass Rubber Stopper Extended in the Welding Fitting.

H-17235 Welding Fitting with Completion Cap as It Remains on the Line.

Proven in Use by America's Major Oil Companies!

The use of Mueller Line Stoppers and Equipment enables you to insert Mueller Rubber Line Stoppers at any desired point in the line and isolate any section regardless of the location of the gate valves. The section of pipe to be repaired or replaced can be shut off completely or by-passed without draining the line.

There are many other uses for this equipment on feeder lines and around refineries and storage plants as the Line Stoppers and Equipment range in size from 1½ to 8 inches.

GAS AND OIL COMPANIES

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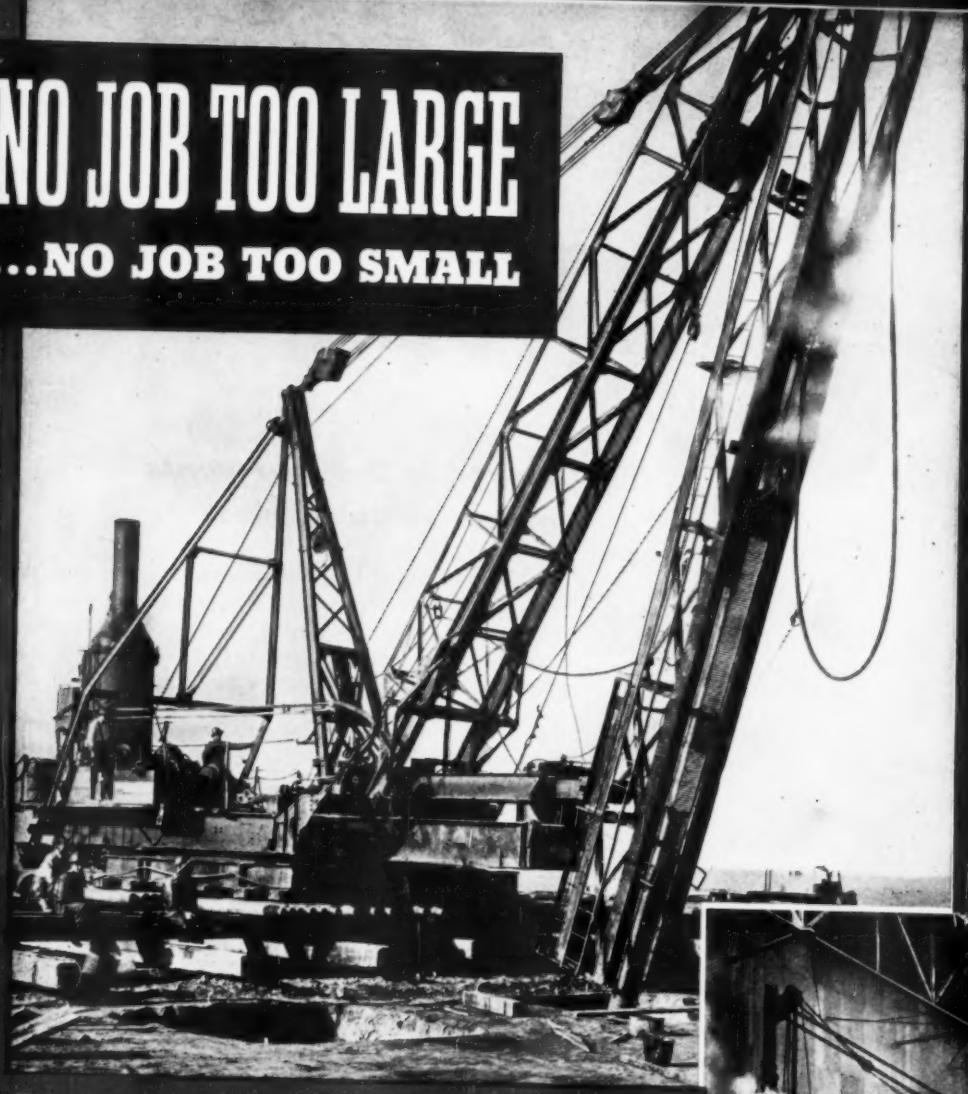
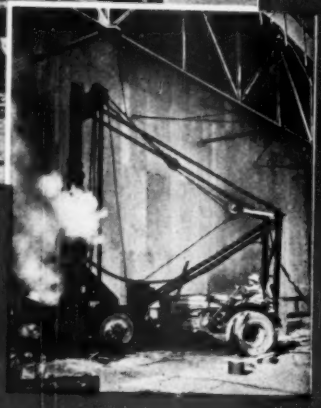
NO JOB TOO LARGE

...NO JOB TOO SMALL





AROUND THE WORLD

From a job of a few piles to one requiring many thousand piles, from a single caisson to a skyscraper foundation, from a simple soil investigation to a complete port development—no job is too large or too small for the Raymond organization. Specialized equipment, broad experience and highly trained personnel are your assurance of dependable work at minimum cost.

Your inquiry will receive prompt attention.

52 YEARS — FOUNDED 1897 — OF PROGRESS

RAYMOND CONCRETE PILE CO.

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Branch Offices in Principal Cities of United States and Latin America

SCOPE OF RAYMOND'S ACTIVITIES includes every recognized type of foundation construction — concrete, composite, precast, steel, pipe and wood piles. Also caissons, underpinning, construction involving shore protection, shipbuilding facilities, harbor and river improvements and borings for soil investigation.

It stops costly leaks for good ... never needs re-packing!

SYLPHON PACKLESS VALVE

Illustrated: cutaway view of No. 304-N Sylphon packless valve. Sizes from ½" to 2" for pressures up to 150 lbs. Larger sizes and types with flanged connections also available. No. 304-NV is ideal for vacuum service.

● Here's a valve that can save you time and money — protect you and your equipment to boot! It stops even tiniest leaks of valuable or hazardous liquids or gases, prevents waste, provides vacuum protection ... and helps guard you and your equipment against explosion, fire and other damage. ● What's more, Sylphon packless valves never require re-packing — because there isn't any! A rugged, dual-ply seamless metal Sylphon bellows replaces the customary stuffing box. It provides a seal that stops costly leaks for good. ● And the bellows is metal-housed for protection against erosion. It seals the valve stem against corrosive, dangerous or inflammable liquids or gases. ● Installed on pipe lines carrying oil, gasoline or other volatile liquids or vapors, Sylphon packless valves are widely used in chemical plants, oil refineries, power plants, aboard ships. ● Get complete information — just write for free Bulletin TO-813.

FS

FIRST WITH BELLOWS

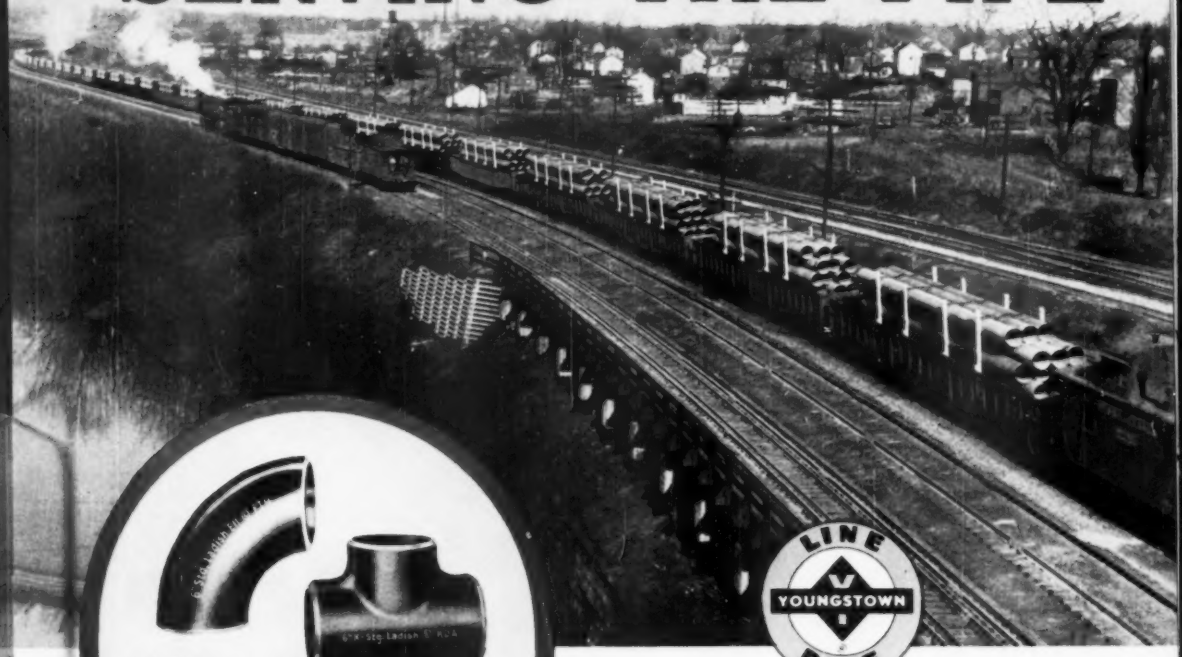
Temperature Controls • Bellows Devices • Bellows Assemblies

FULTON SYLPHON
DIVISION

ROBERTSHAW FULTON CONTROLS CO., KNOXVILLE 4, TENN.

Canadian Representatives, Darling Brothers, Montreal

SERVING THE PIPE



LADISH

YOUNGSTOWN LINE PIPE
WALWORTH VALVES
NORDSTROM VALVES
LADISH FITTINGS & FLANGES

These are names long familiar to men of the Pipe Line industry who demand the best in quality and service. They are typical of the many fine product names offered through Continental.

Whatever your requirements in equipment and supplies, call on Continental. One of the 72 Continental stores and offices is ready to serve you promptly and properly.

THE CONTINENTAL SUPPLY COMPANY, *General Offices:* DALLAS, TEXAS

The Continental Supply Company, Limited, 216 Lancaster Building, Calgary, Alberta

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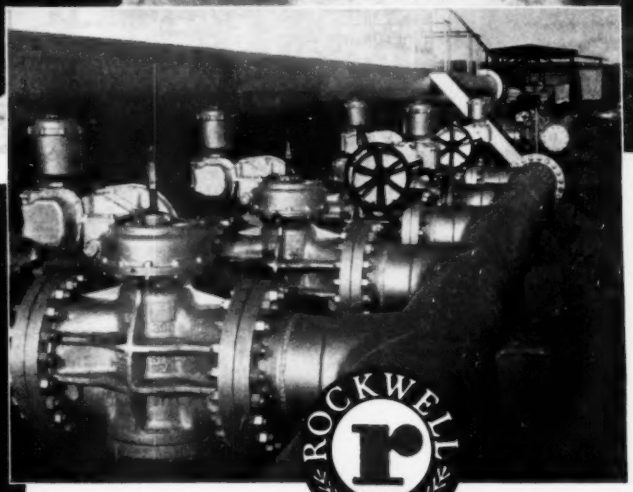
LINE INDUSTRY...

with Quality Equipment

YOUNGSTOWN Line Pipe . . .
miles of it . . . goes out to become a part of the world's finest and most extensive pipe line network.



ROCKWELL

NORDSTROM
Valve Division

W WALWORTH

CONTINENTAL

Representatives: ARGENTINA • BOLIVIA • BRAZIL • CHILE • CHINA • COLOMBIA • ENGLAND • ECUADOR • PERU • TRINIDAD • URUGUAY • VENEZUELA

In case of emergency, BJ will fly engineers, repair crews, and equipment to your operation.

ARE YOU TAKING ADVANTAGE of the services offered by BJ in keeping pump performance at "peak" levels? Whether for design, installation, maintenance, parts replacement or for an analysis of your pump needs — BJ offers you the advantages of a sound service program and a pioneer background in the successful application of centrifugal pumps.

CALL your local BJ Representative if a service or installation problem is confronting you. Or write direct for specialized engineering assistance.

BJ

SERVICES PROMOTE EFFICIENCY IN YOUR PLANT

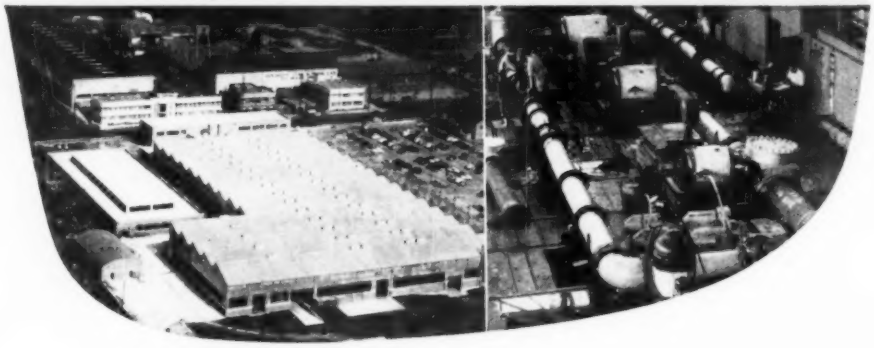
- 4 strategic factory locations: Bethlehem, Pa;. Houston, Tex.; Los Angeles, Calif.; Fresno, Calif.
- Service Departments within each factory organization
- Specialized engineer-designer assistance
- Field engineers for on-the-spot consultations
- Factory and Dealer sales and service organizations
- Half-million-dollar Hydraulic Testing Laboratory— the world's most modern
- Quick emergency services possible with company-owned airplane

Byron Jackson Co.
Since 1872

LOS ANGELES 54, CALIFORNIA • *Offices in principal cities*
Plants: Los Angeles • Bethlehem • Houston • Fresno

Air view of the modern Byron Jackson Los Angeles Plant—completed in 1946. The capacities of this new Plant are complemented by the other three BJ Plants.

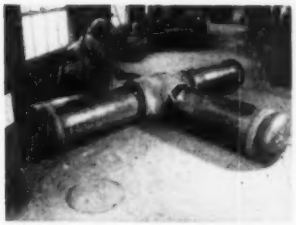
The new Testing Laboratory offers you the most modern pump-testing facilities. Here—the design, workmanship, reliability of assemblies, and actual operating efficiencies of BJ Pumps are conclusively tested before shipping.



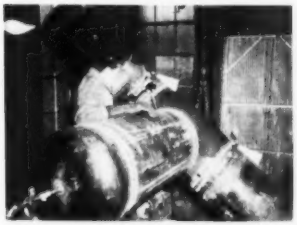
TUBE-TURN

tt

WELDING FITTINGS AND FLANGES



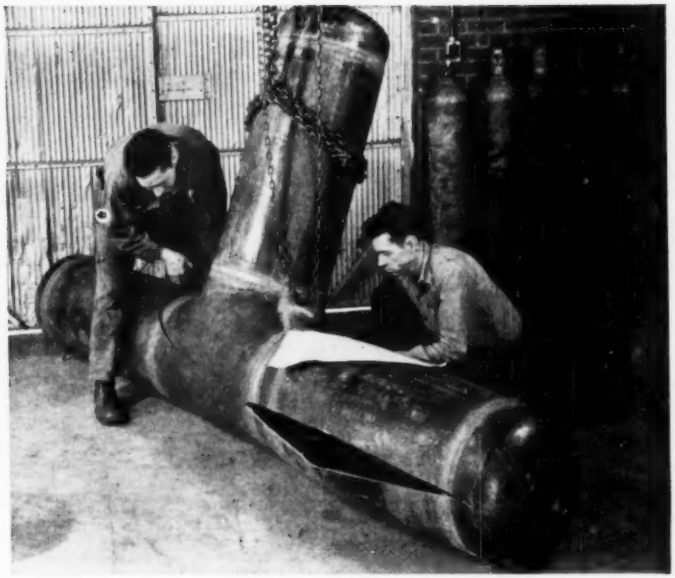
18-inch standard weight Tube-Turn welding tee and pipe laid out preparatory to assembly for hydrostatic pressure test.



Welder completing last bead in assembly. Fitting and pipe now form homogeneous, leakproof unit.

Assembly is hung in pit, massively lined with concrete. During test top grating is closed and held down by a barricade of sandbags.

Final result after hydrostatic pressure test. The straight pipe burst first, and the tee is undamaged.



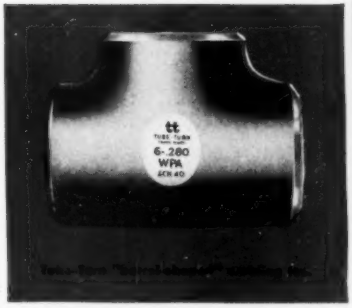
Strength through Design in Tube-Turn welding fittings

The pipe burst first!

Take an 18-inch standard weight welding tee. Take three corresponding lengths of pipe. Weld tee and pipe together. Cap the ends. Lower the assembly into a pit. Then apply hydrostatic pressure—much more than the assembly is supposed to take!

Something has to give! According to the accepted beliefs it should be the tee. But not in the case of the test pictured here. The Tube-Turn "barrel-shaped" tee was used—and the pipe burst, well before the tee was affected! Throughout numerous tests, this new type of tee has withstood at least 25 per cent more pressure than required by the formula given in ASA B16.9.

The superior strength of the tee was achieved without running up extra weight and cost, by carefully planned improvements in shape (based on the sphere, nature's strongest form for internal pressure), and by a carefully engineered distribution of metal.

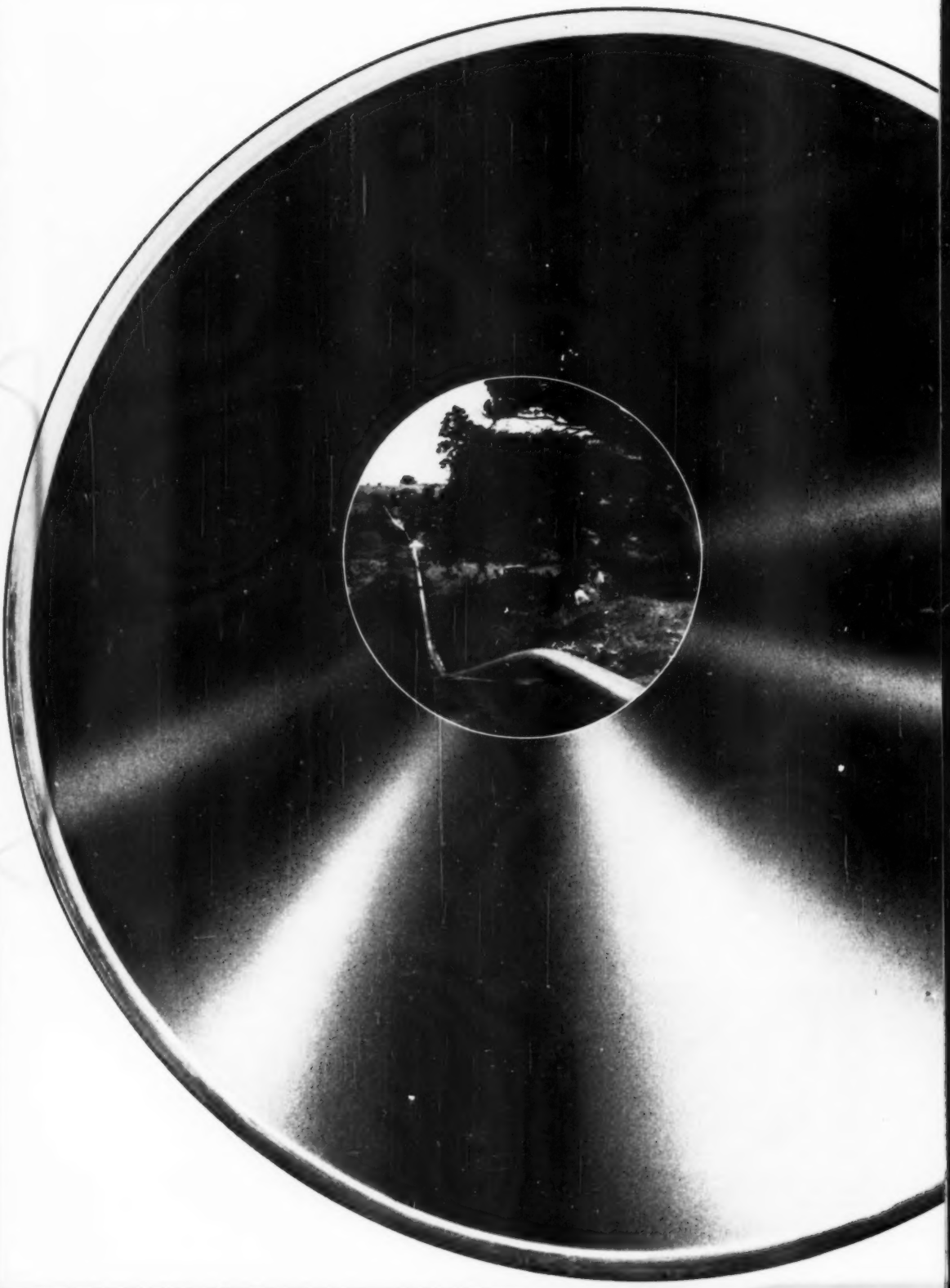


This is a typical example of *strength through design* in Tube-Turn welding fittings, and another good reason why leading piping engineers specify Tube-Turn equipped, welded piping.

TUBE TURNS, INC.

240 East Broadway, Dept. K, Louisville 1, Kentucky

District Offices at New York, Philadelphia, Pittsburgh, Chicago, Houston, Tulsa, San Francisco, Los Angeles



J&L PIPE

Controlled Quality

Line Pipe

JONES & LAUGHLIN SUPPLY COMPANY

Subsidiary of Jones & Laughlin Steel Corporation

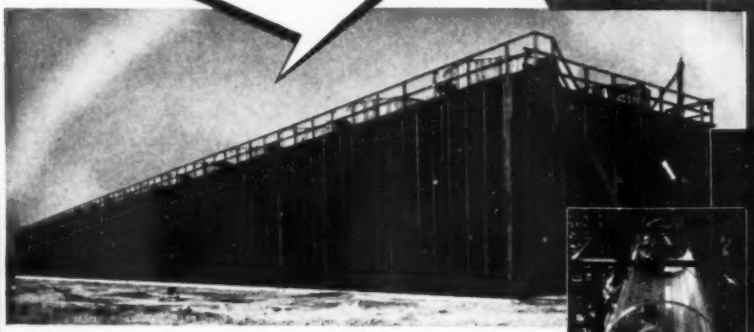
Ask for Bulletin O.C.S.

TULSA, OKLAHOMA

WCEC

. . . . . FOR THE WORLD'S LARGEST LUBE PLANT

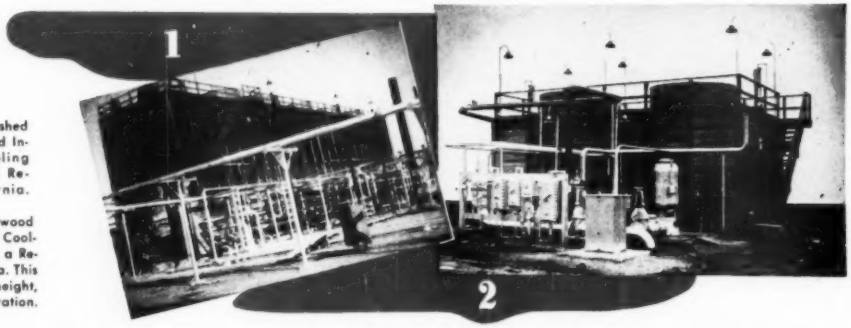
COOLING TOWERS are handling the toughest jobs in the PETROLEUM INDUSTRY



The world's largest . . . 51,000 gals. of water per minute . . . 3,060,000 gals. per hour . . . 73,440,000 gals. of water per 24-hour day . . . cooled to a guaranteed temperature with this 34-cell Multi-Stage, Redwood Induced Draft Cooling Tower, engineered especially for Lube Plant in Louisiana.

Is 48-in. in diameter, banded at regular intervals.

SERVING THE SPECIALIZED NEEDS OF REFINERIES EVERYWHERE



1. Six-Cell, coil shed type, Redwood Induced Draft Cooling Tower serving a Refinery in California.

2. Two-Cell, Redwood Induced Draft Cooling Tower serving a Refinery in Oklahoma. This Tower is low in height, economical in operation.

ADVANCED ENGINEERING DESIGN MEANS SUPERIOR PERFORMANCE

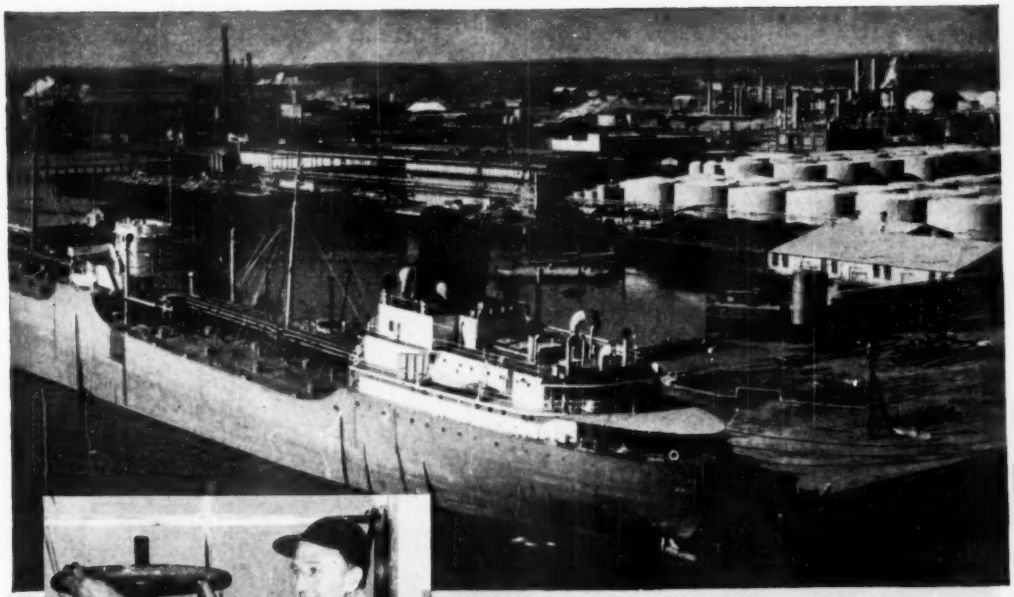
TODAY'S WATER COOLING PROBLEMS CANNOT BE SOLVED WITH YESTERDAY'S METHODS

WCEC Cooling Towers today are being designed and built to handle any specified service demanded by any specific industry. In the Petroleum field, for instance, WCEC has designed and engineered a Cooling Tower meeting the specialized needs of the World's Largest Lube Plant. What we have done for them, we can do for you.

WATER COOLING EQUIPMENT COMPANY

FABRICATING PLANTS • • • ARCATA, CALIFORNIA • • • HOUSTON, TEXAS • • • ST. LOUIS, MISSOURI

ADDRESS INQUIRIES HOME OFFICE: ST. LOUIS 23, MO.



CUT PUMPING COSTS

WITH

OIC

PACE-SETTER IN VALVES

SUN OIL COMPANY

OIC Valves play an important role for the Sun Oil Co. at Philadelphia, Pa., in the movement of crude oil from the tanker to tank storage. OIC valves also give efficient service on a wide variety of other uses.

Shown here is a Sun Oil pumpman operating an OIC Valve installed inside a booster pumphouse. This valve is on a 12-inch pipeline extending from the piers to a crude oil storage area.

OIC Valves Give Maximum Flow with Minimum Pressure Drop!

OIC's long line of valves are designed to solve your many service needs.

OIC **Gate Valves** with flanged or welding ends provide straight-through flow without recesses or pockets between the valve ports and seat openings. Screwed end valves are designed for the smoothest possible flow with a threaded joint.

OIC **Globe and Angle Valves** are designed with stem-disc guiding construction in all pressure classes to eliminate the necessity of a bridge across the seat opening. This reduces, to an absolute minimum, pressure loss through the diaphragm. Flow of the line fluid, whether gaseous or liquid, is expedited.

OIC **Check Valves** have bodies designed for unobstructed flow where the disc is in the wide open position. Streamlined internal contours from port to port reduce turbulence (and consequent pressure loss) to a minimum.

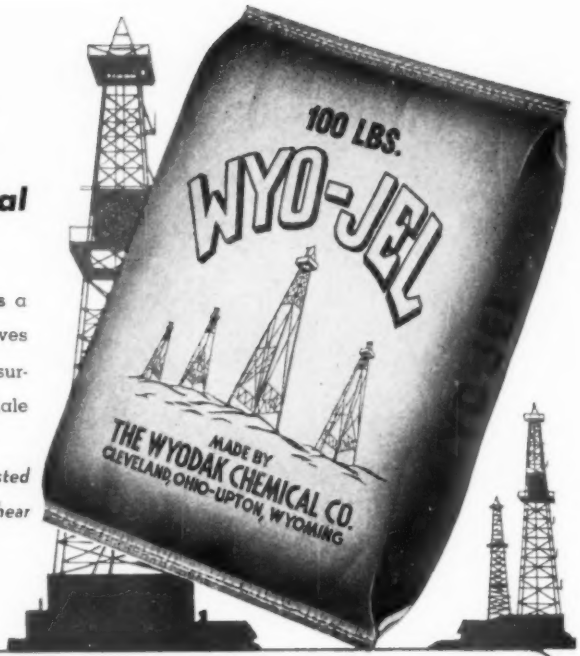
Get your copy of the OIC Cross Reference Chart

You can look at the figure number of the valve on the line, refer to this handy chart and find quickly the OIC Valve which replaces it. To reserve your copy, write to **The Ohio Injector Company, Wadsworth, Ohio.**

OIC **VALVES**

CAST STEEL • FORGED STEEL • IRON • BRONZE

ROTARY MUD TEST on WYO-JEL . . . *the ideal drilling mud material*



● **Added to drilling mud, Wyo-Jel produces** a high-yield mud . . . lengthens the life, improves suspending and lubricating qualities. Unsurpassed for preventing caving by penetrating shale or loose formation to great depths.

Distributors, Attention . . . *If you are interested in handling this popular material, we would like to hear from you.*

ROTARY MUD TEST BY HORNKOHL LABORATORIES, BAKERSFIELD, CALIF.

Sample from Bakersfield Warehouse Stock

● Several mixes were made to arrive at the correct percentage to yield a mud having a Stormer Centipoise Viscosity of 15; the tests below show the results on the mix having the desired viscosity shown.

Per cent Clay in Mix	6.0
Per cent Water in Mix	94.0
WEIGHT TESTS	
Pounds per cubic foot	65.1
Pounds per gallon	8.68
Specific Gravity	1.045
Lbs. sq. ft./100 feet	44.90
VISCOSITY TESTS	
Marsh Funnel, API, Seconds (1500 CC in — 1 Qt. out)	47.3
Stormer Centipoises at 600 R.P.M.	15.0
FREE WATER SEPARATING	
1st hour	0.0
2nd hour	0.0
18th hour	0.0
ELUTRIATION TEST	
% Sand in Rotary Mud	0.05
SHEAR TEST (in lbs./sq. ft.)	
At start	0.0
After ten minutes	0.0

SALINITY OF ROTARY MUD

Grains per Gallon 3.40

WALL BUILDING TEST (Filter Cake)

Test at 100 lbs./sq. in. and Atmospheric Temperature

Time	cc. Water off	cc. per min.
1st Minute	1.3	1.30
5th Minute	4.2	0.84
10th Minute	6.4	0.64
15th Minute	8.0	0.53
30th Minute	11.9	0.40
60th Minute	17.2	0.29

cc. Water off 5th - 15th Minute 3.8

Thickness of Filter Cake, Inches 3/32

Test at 1000 lbs./sq. in. and 150° F Temperature

Time	cc. Water off	cc. per min.
1st Minute	5.8	5.80
5th Minute	10.0	2.00
10th Minute	13.8	1.38
15th Minute	16.4	1.10
30th Minute	23.2	0.77
60th Minute	32.0	0.54

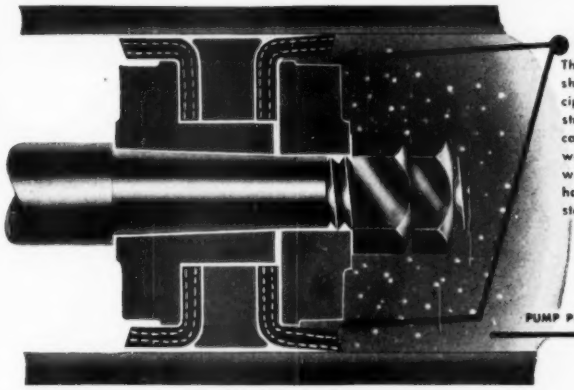
cc. Water off 5th - 15th Minute 6.4

Thickness of Filter Cake, Inches 5/32

Yield: Barrels of Mud per ton of clay 100

The Wyodak Chemical Company,
4600 East 71st St., Cleveland 5, Ohio

WYO-JEL



This greatly exaggerated diagram shows the Darcova Pumcup principle. On pressure side of each piston stroke, flexible Pumcup is automatically forced against liner or cylinder wall. Firm, uniform contact all the way around eliminates slippage, holds volumetric efficiency at constant high in spite of gradual wear.

PUMP PISTON MOTION

THEY NEVER RELAX
when the pressure is on!

HERE is a piston packing that actually takes *advantage* of the fluid pressure built up in reciprocating pumps and in air or hydraulic mechanisms. The illustration above shows how Darcova Pumcups utilize this pressure . . . how they hug the cylinder wall on every work-stroke of the piston, preventing needless slippage.

Then, too, friction between the Pumcup and cylinder is automatically "pressure-equalized" all the way around for a uniformity of wear otherwise impossible. And, in contrast to other types of packing, fluid slippage does not increase with wear. Peak volumetric efficiency is retained even when Pumcup wear is far advanced.

Consequently, Pumcups offer two mighty important advantages. First, downtime and material and maintenance costs are cut to a fraction because Pumcups outlast other types of packing many times over. Secondly, volumetric efficiency is held constant.

Everything considered, it is easy to see how thousands of Darcova Pumcup users are saving up to $100 per pump per year. Easily installed, Pumcups replace ordinary packing in reciprocating pumps and in air or hydraulic mechanisms. They are precision built in ½ to 42 inch sizes and in many different textures for practically all fluids, pressures and temperatures.

DARCOVA®
THE ORIGINAL COMPOSITION CUP

***FREE BULLETIN**—For a free bulletin containing complete information, write, or use the coupon below.*

DARLING VALVE & Manufacturing Co.
WILLIAMSPORT, PA.

Darling Valve & Mfg. Co., Williamsport 1, Pa.
Please send me the free bulletin checked below:
☐ No. 4401 Darcova Pumcups for reciprocating pumps.
☐ No. 4502 Darcova Pumcups for air or hydraulic mechanisms.

Name_____
Company_____
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This Simple Compressor Meets the Complex Needs of a Changing Petroleum Industry

It's the Nash!

Here is a compressor presenting advantages found in no other device. Nash Compressors have only one moving part, rotating without metallic contact with the pump casing. No internal lubrication is required. Yet they produce 75 lbs. pressure in a single stage, with capacities to 6 million cu. ft. per day in a single structure.

There are no valves, gears, pistons, sliding vanes, or other complicated wearing parts in a Nash. Compression is secured by an entirely different principle of operation. Because of this, gas pumping problems difficult with ordinary pumps are often easily handled by the Nash. For example, Nash Pumps are standard equipment in the Synthetic Rubber Industry, where they have met the needs of new and difficult processes.

Nash Compressors are compact and save space. They run without vibration, and compression is without pulsation. They maintain original performance over long periods. Service is assured by a nationwide net-work of Engineering Service offices. Instructive bulletin shows how they operate. Write for it.

One moving part.

No internal wearing parts.

No valves, pistons, or sliding vanes.

No internal lubrication.

Low maintenance.

Slugs of liquid entering pump do no harm.

Non-pulsating pressure.

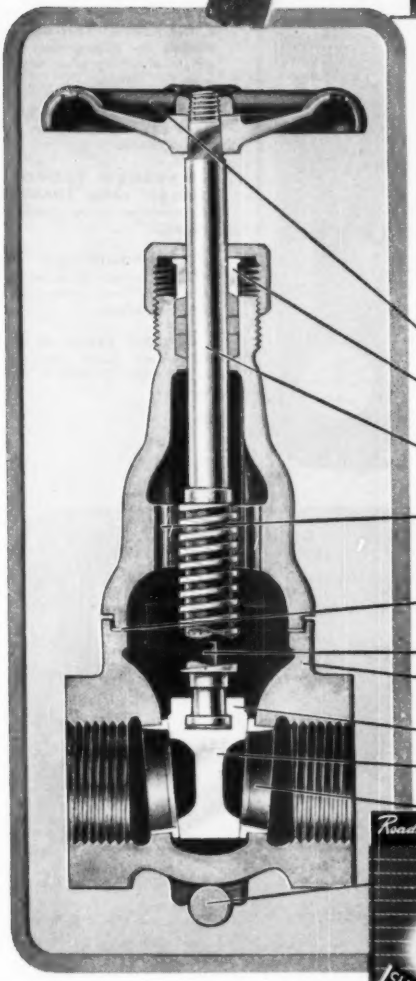
Saves floor space.

75 pounds in a single stage.

NASH ENGINEERING COMPANY

273 WILSON, SO. NORWALK, CONN.

many features in this R-P&C valve



CLIP GATES were originally developed for temporary or light services in which a small iron valve was necessary or acceptable. But the design, material and workmanship of the READING-PRATT & CADY clip has made it a popular all-around small iron gate valve—suitable for almost any application within its size, pressure and temperature range.

Read the highlight features listed below. And for more detailed information, get in touch with the R-P&C District Office or Distributor nearest you.

1. **Kool-grip malleable iron ventilated hand-wheel.**
2. **Deep stuffing box with follower. Can be packed under pressure.**
3. **Stem of high strength steel or bronze rod stock.**
4. **Bronze bushing in brass-mounted type. Full, adequate bonnet drain prevents possible trouble from freezing in outside installations.**
5. **Male and female bonnet joint with asbestos gasket.**
6. **Full-sized wedge guides cast in body.**
7. **Body and bonnet of close-grained Electric Cast Iron—50% stronger than ordinary iron.**
8. **Horseshoe type slip-on connection.**
9. **Heavy cast I-beam wedge—reversible and renewable. Wedge rises above flow when open.**
10. **Rolled-in seat ring (in bronze-mounted type).**
11. **Full U-bolt in closed bolt holes. Held in place by 3 sets of lugs on body.**

***SEND** for this descriptive folder*

about R-P&C Clip Gate Valves.
Just ask for **DH-952.**

ACCO

Reading, Pa. • Atlanta • Baltimore • Boston • Chicago • Denver • Detroit • Houston
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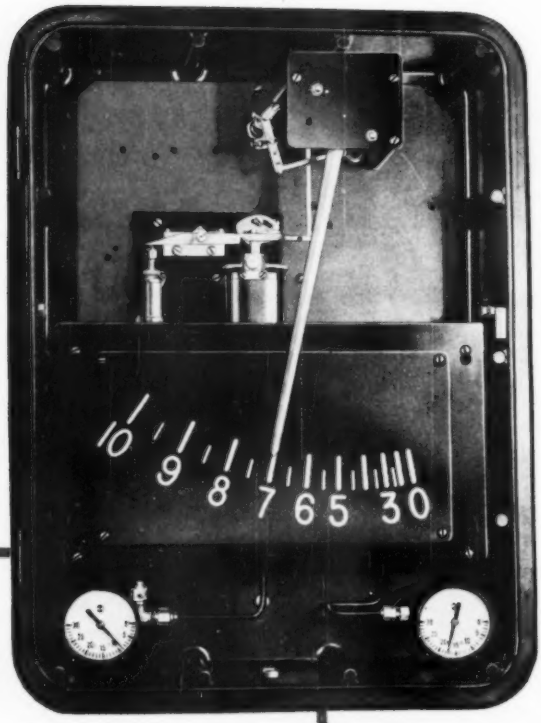
R-P & C VALVE DIVISION
AMERICAN CHAIN & CABLE

READING-PRATT & CADY VALVES



1. NO NEED TO BREAK TUBING CONNECTION for nozzle adjustment.

2. INSTRUMENT CAN BE REVERSED by shifting one link without disturbing other adjustments.

3. LINKAGE ALIGNMENT MADE EASY IN FIELD with positioning device.

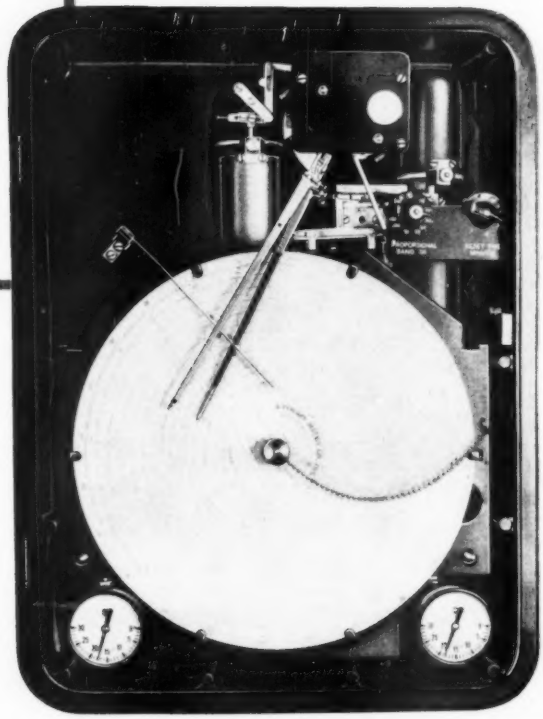
4. MAXIMUM PROPORTIONAL BAND CHANGES with minimum output pressure changes.

5. EASY POSITIONING OF NOZZLE permits widening of proportional band without disconnecting tubing.

6. DAMPING DEVICE IN RELAY insures smooth operation. Primary orifice in relay is self-cleaning.

SERIES A-88

PNEUMATIC TRANSMITTER AND CONTROLLER



The eight outstanding features of the new American Meter Company Series A-88 pneumatic Transmitter and Controller point to just one all-important accomplishment — the solution to numerous servicing and maintenance problems in the control of flow, pressure, liquid level and specific gravity.

7. RESET VALVE IS SPRING-CLOSING and sealed w.th bellows. It is calibrated according to time.

8. LINEARITY ADJUSTMENT between transmitter and receiver.

ADDITIONAL POINTS DESCRIBED IN BULLETIN CT-49. The eight servicing and maintenance points listed cover only a few of the features technically described in the Bullet'n pictured below.

It w:ll be of interest to Instrument men who wish to keep in touch with the latest deve'opments in instruments control. Write for a copy.

AMERICAN METER COMPANY

Albany • Alhambra • Atlanta • Baltimore • Birmingham • Boston • Chicago • Dallas
Denver • Erie • Fort Lauderdale • Houston • Joliet • Kansas City • Los Angeles • Minneapolis
Odessa • Philadelphia • Pittsburgh • San Francisco • Tulsa
In Canada—Canadian Meter Co., Ltd., Hamilton, Ont.

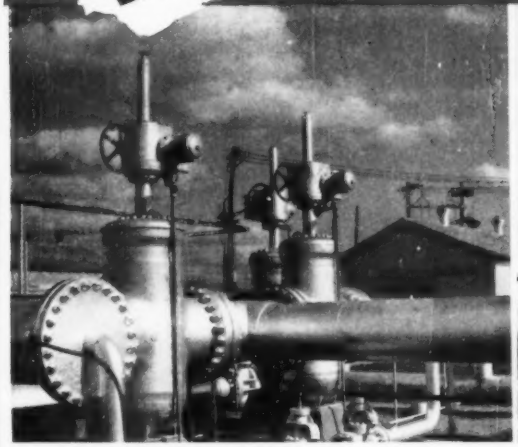
another tribute to "LIMITORQUE"

...BASIN-OZARK PIPE LINES

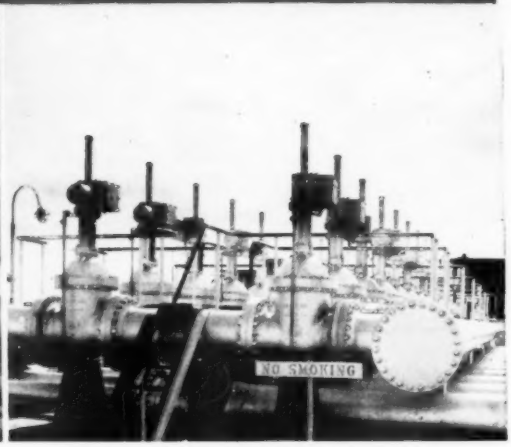
USE MORE THAN

200 LIMITORQUE

MOTOR-OPERATED VALVE CONTROLS



Showing 3 (of many) "LimiTorque" Motor Operated Valve Controls installed on "W-K-M" Valves . . . for remote control on pipe line manifold, crude oil line.



Showing 18 (of many) "LimiTorque" Motor Operated Valve Controls installed on "Darling" Valves . . . for remote control on pipe line manifold, crude oil line.

The "Basin-Ozark" Pipe System consists of a total of about 950 miles of 20", 22", 24" diameter pipe—running from Wichita Falls, Texas, to Wood River, Illinois, and is one of the largest lines ever built by private capital. Through the Texas Pipe Line Co., Shell Pipe Line Corp. and the Empire Pipeline Co., we were privileged to supply over 200 "LIMITORQUE" Motor Operated Valve Controls.

"LIMITORQUE," as the name implies, *limits the torque applied to the operating parts* (due to an exclusive, patented "torque switch")—and thus prevents damage to discs, stems, seats, etc. Further, "LIMITORQUE" Valve Operators permit local or remote push-button control; save time, labor and money; close valves at exact speed required, and are absolutely dependable and safe . . . and they utilize any power source: electricity, oil, gas, water or air.

Thousands upon thousands of "LIMITORQUES" are used throughout the world in Oil Pipe Lines, Refineries, Central Stations, Power Plants, Water and Sewerage Plants, Gas Companies, Chemical and Process Plants, and on Shipboard.

Note: The valves on which the above mentioned "LIMITORQUES" are installed were manufactured by Darling Valve & Manufacturing Co. and W. K. M. Company.

Our 96-page catalog shows different types; how they work; how they are connected; wiring diagrams; control panels; floor stands; position indicators; installation views; views of "LIMITORQUES" applied to most all makes of valves—indeed, a veritable "treatise" on Motorized Valve Operation.

Please be sure to use your **business letterhead** when writing for this valuable catalog.

Philadelphia Gear Works, INC.

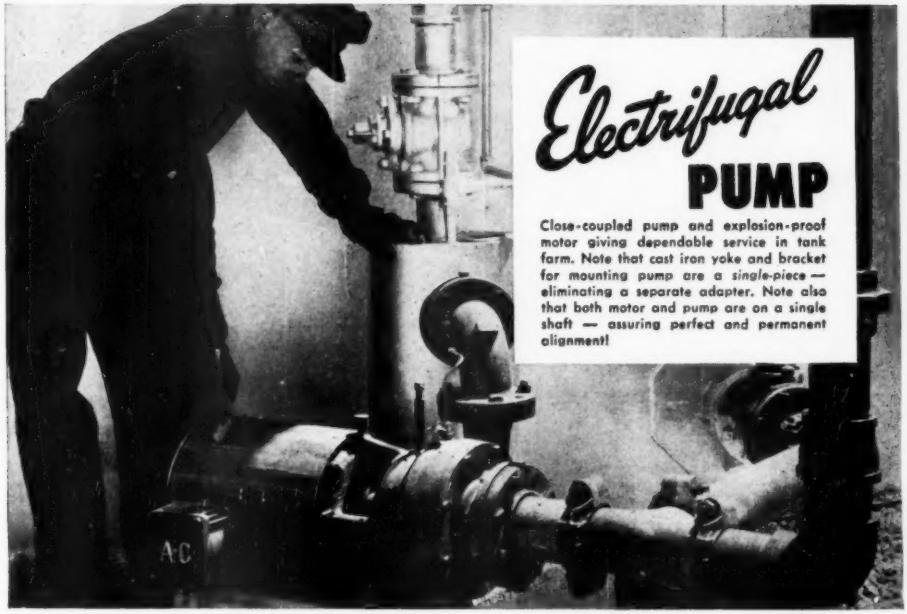
ERIE AVE. AND G ST., PHILADELPHIA 34, PA.

NEW YORK • PITTSBURGH • CHICAGO • HOUSTON

IN CANADA: WILLIAM AND J. G. GREEY LIMITED, TORONTO

Industrial Gears and Speed Reducers
LimiTorque Valve Controls

How Unit Construction Cuts Petroleum Pumping Costs


Electrifugal
PUMP
Close-coupled pump and explosion-proof motor giving dependable service in tank farm. Note that cast iron yoke and bracket for mounting pump are a single-piece — eliminating a separate adapter. Note also that both motor and pump are on a single shaft — assuring perfect and permanent alignment!
A-C

SAVES YOU MONEY THESE 3 WAYS:

- **In Installation** — Installation is easier, quicker — pump comes ready to run. No alignment problems. No extra parts. Easy to handle. Requires small space.
- **In Operation** — Pump and motor designed together to give high efficiency. Every unit tested and guaranteed.
- **In Maintenance** — Cannot get out of alignment. Has fewer parts and fewer machined fits. Bronze wearing ring protects casing from wear and is easily replaced when required.

The *Electrifugal* pump, ranging from 10 to 1600 gpm with heads to 525 feet, is just one of many types of pumps built by Allis-Chalmers for industrial service. You can depend on the recommendations of the A-C pump application engineer to give you dependable service at lowest cost. For information, see your Allis-Chalmers Authorized Dealer or Sales Office or write for Bulletin 52B6059E. A-2774

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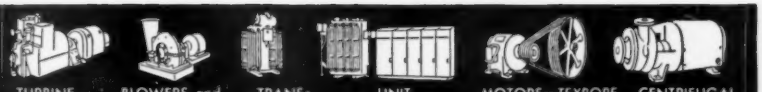
Electrifugal and *Texrope* are Allis-Chalmers trademarks.

ALLIS-CHALMERS

Power, Electrical, Processing Equipment for Petroleum Industry



4 BRAND NEW MICHIGAN TRUCK SHOVEL-CRANES...

SERIES 8

½ YARD
8 TON

Here's a range of four completely new half-yard MICHIGANS designed to meet *your* particular job requirements. Your choice of *single-engine* power or *twin-engine* power, *two-wheel drive* or *four-wheel drive*. Remote control, which permits fast, easy maneuvering on the job, is available as optional equipment on the twin-engine models.

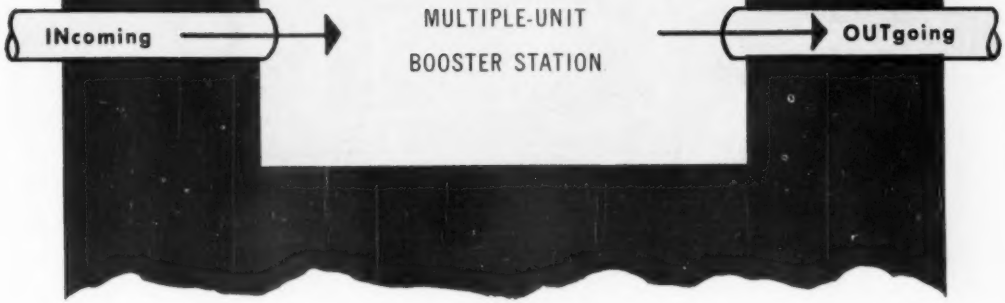
Get all the facts! Write for your copy of Bulletin 101.

MICHIGAN

MICHIGAN POWER SHOVEL CO.

225 MILLER STREET, BENTON HARBOR, MICHIGAN, U.S.A.

From the "IN" to the "OUT" of your Booster Station



. . . use Brown Advanced Instrumentation

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*Electroni*K Pyrometers • *Electroni*K Precision Indicators • *Electroni*K Multiple Strip-Chart Recorders • *Electroni*K Tachometers • Mechanical Flow Meters With Air Control • Pressure Regulators • Belfield Diaphragm Control Valves

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BOOSTER STATIONS may vary in size, capacity and physical layout . . . but Brown Control Systems fit them all. They afford the time-saving convenience of panel board centralization for indicating, recording and controlling.

Here is what is accomplished: automatic adjustment of station capacity to line through-put . . . automatic limitation of the minimum value of station inbound pressure and maximum value of station outbound pressure . . . automatic safeguards to keep a station on the line and sound alarm in case of emergency.

Brown Advanced Instrumentation is keeping pace with pipe line developments and provides the far-reaching facilities of the entire network of Minneapolis-Honeywell branch offices and field engineers. Call in your local Honeywell engineer, today . . . for detailed information on Booster Station Control Systems.

MINNEAPOLIS-HONEYWELL REGULATOR CO.
BROWN INSTRUMENTS DIVISION
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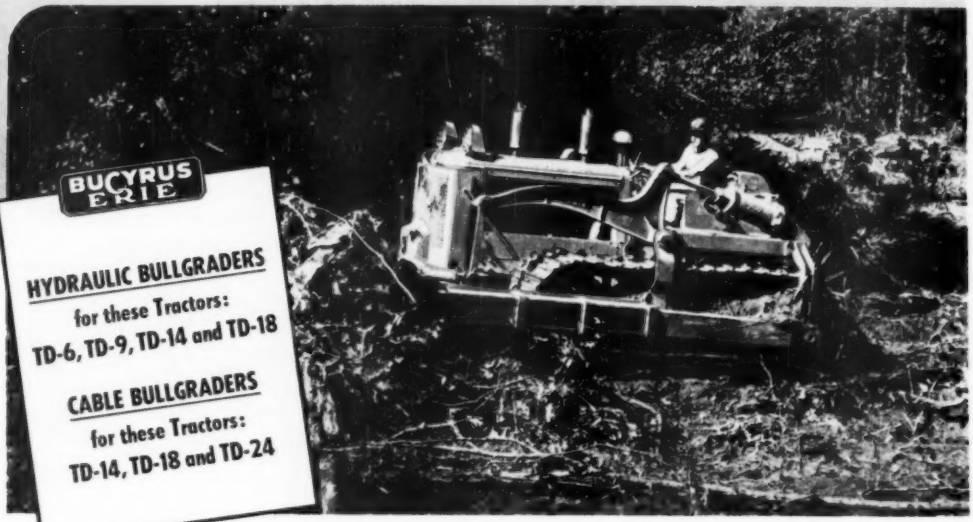
MINNEAPOLIS Honeywell — *Advanced Instrumentation* FOR THE PETROLEUM INDUSTRY — BROWN INSTRUMENTS

Pace Your Spread with this Tough Right-of-Way Boss



Here are four big reasons why you'll clear more miles of right-of-way per day with Bucyrus-Erie Bullgraders leading the way:

1 **Road approaches are leveled faster because scientifically curved Bucyrus-Erie blades keep the dirt rolling . . . move greater yardages per tractor horsepower.**

2 **Big boulders and other fence line obstructions are pushed aside easily without excessive wear on tough Manten steel blade.**

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4 **Perfect balance of the mounted Bullgrader unit gives complete track contact and full use of tractor power at all times.**

Bucyrus-Erie's experience as manufacturer of the largest complete line of tractor equipment shows up in the superior output delivered by your Bullgrader. Set new progress records by equipping your right-of-way crew with this hardworking tool.

BUCYRUS-ERIE COMPANY
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Geared to industry's continuous demand for specialized metals, Metal Goods' one-call service is designed to make your metal procurement easier—and more efficient. By having the metals you need "on-call" from your Metal Goods warehouse—*when* you need them—you can eliminate costly metal inventories... save storage space... reduce materials handling... and gain efficiency through simplifying your supply effort.

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Tube Sheets... Naval Brass... Muntz Metal

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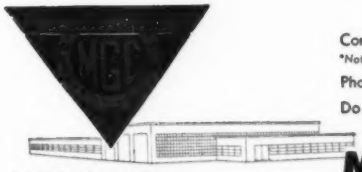
Consult your Metal Goods metallurgical specialist on the proper metal for your application.

**Not warehoused in Kansas City or St. Louis*

Phone, wire or write your Metal Goods warehouse for your specialized metal needs.

Do you have the "Metalog"? It's a complete stock list and metal manual — Write for it!



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LUNKENHEIMER manufactures high quality Globe, Gate, Angle and Check Valves in bronze, iron and steel for all pressures and temperatures. Wherever oil is produced, processed or transported, you'll find them specified for dependability and low-cost upkeep.

Lunkenheimer Distributors are stocked and equipped to provide prompt service in every oil producing center.

Eight inch gate valves—
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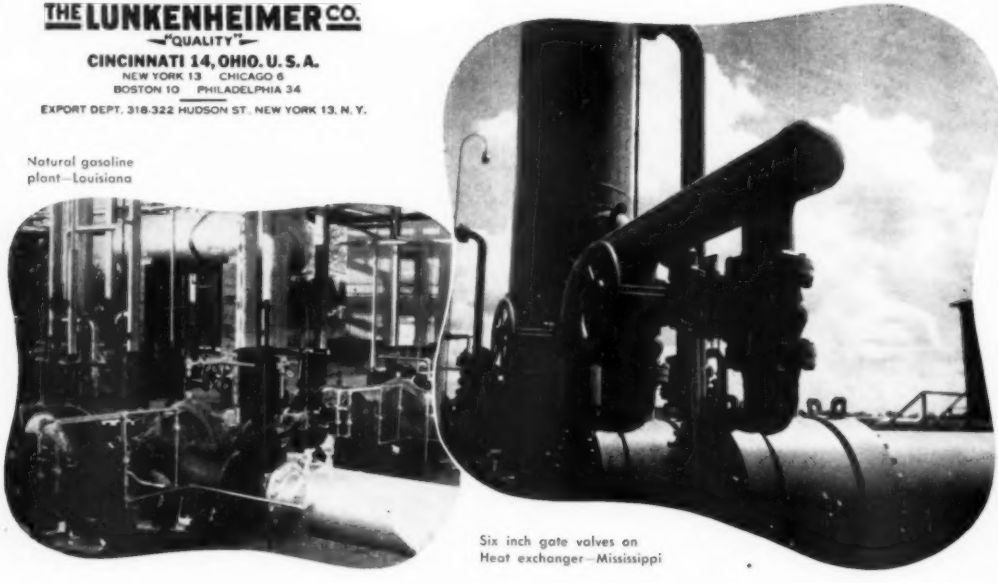
plant—Louisiana



Six inch gate valves on
Heat exchanger—Mississippi

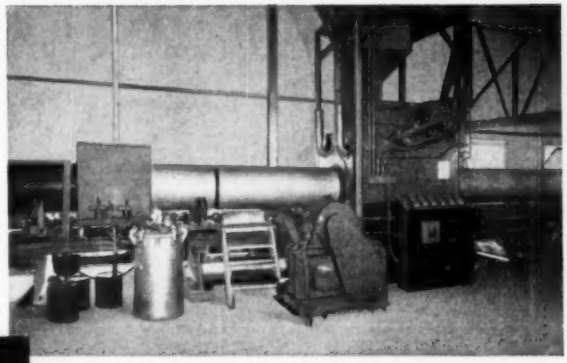
FAR LONGER PIPE LIFE

NOW! with Hill, Hubbell-engineered "Roto-Grit-Blast"... the industry's most advanced, most effective angular steel-grit blasting process!

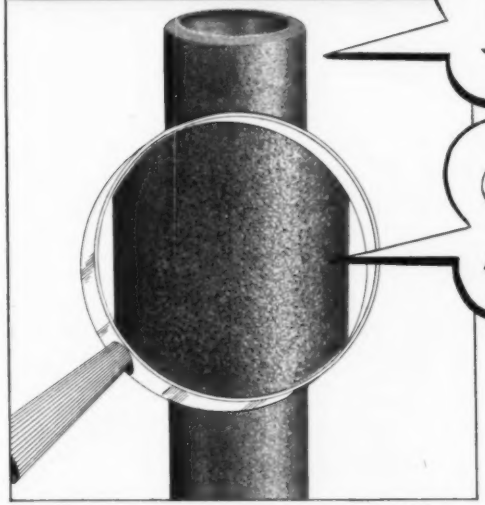
Corrosion authorities agree! The *foundation* for coating and wrapping is one of the most important factors in pipe life. Unless there is positive, *permanently-keyed* bond between pipe and primer, the coating and wrapping can easily fracture or even become entirely destroyed!

That is why Hill, Hubbell engineers developed "Roto-Grit-Blast"—the industry's most advanced method of pipe protection. Steel grits are blasted against the pipe surface, cleaning and etching it metal-bright to provide a *permanent* bond for coating and wrapping.

This *factory* method assures more than ever that Hill, Hubbell-protected steel pipe is *sealed and safeguarded* against every possible agent of corrosion!



"ROTO-GRIT-BLAST"— surest, most positive method of pipe preparation:



1 Removes every trace of mill scale, rust, dirt... leaves the pipe ***METAL-BRIGHT DUST-CLEAN***

2 ***ETCHES*** the pipe to assure perfect, positive bond of primer, coatings!

"Roto-Grit-Blast" is still another reason why Hill, Hubbell is more than ever the PIONEER IN PIPE PROTECTION!

Send for ACTUAL SAMPLE of "Roto-Grit-Blasted" Pipe!

Hill, Hubbell and Company
Division of General Paint Corporation
3091 Mayfield Road, Cleveland 18, Ohio A-10

Please send me an actual sample of steel pipe cleaned and etched by your "Roto-Grit-Blast" process of angular steel-grit blasting. Thank you.

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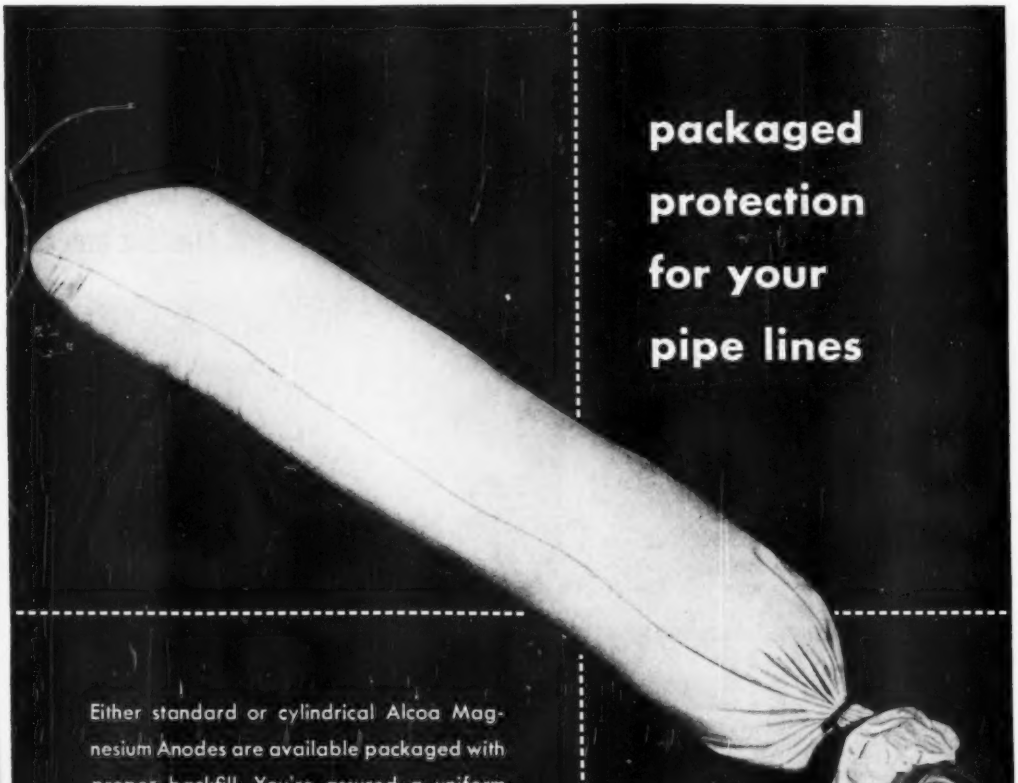
Firm _____

Address _____

City _____ State _____

Hill, Hubbell and Company
Division of GENERAL PAINT CORPORATION
3091 MAYFIELD ROAD, CLEVELAND 18, OHIO



packaged protection for your pipe lines

Either standard or cylindrical Alcoa Magnesium Anodes are available packaged with proper backfill. You're assured a uniform backfill of standard composition. Packaged anodes reduce technical supervision and stop waste of materials at the installation. And you'll cut installation time . . . can install them easily in swampy or marshy ground.

Ask your nearby Alcoa sales office for copies of booklets to help explain Alcoa cathodic protection to all interested members of your organization. Or write to ALUMINUM COMPANY OF AMERICA, 625 Gulf Building, Pittsburgh 19, Pennsylvania.

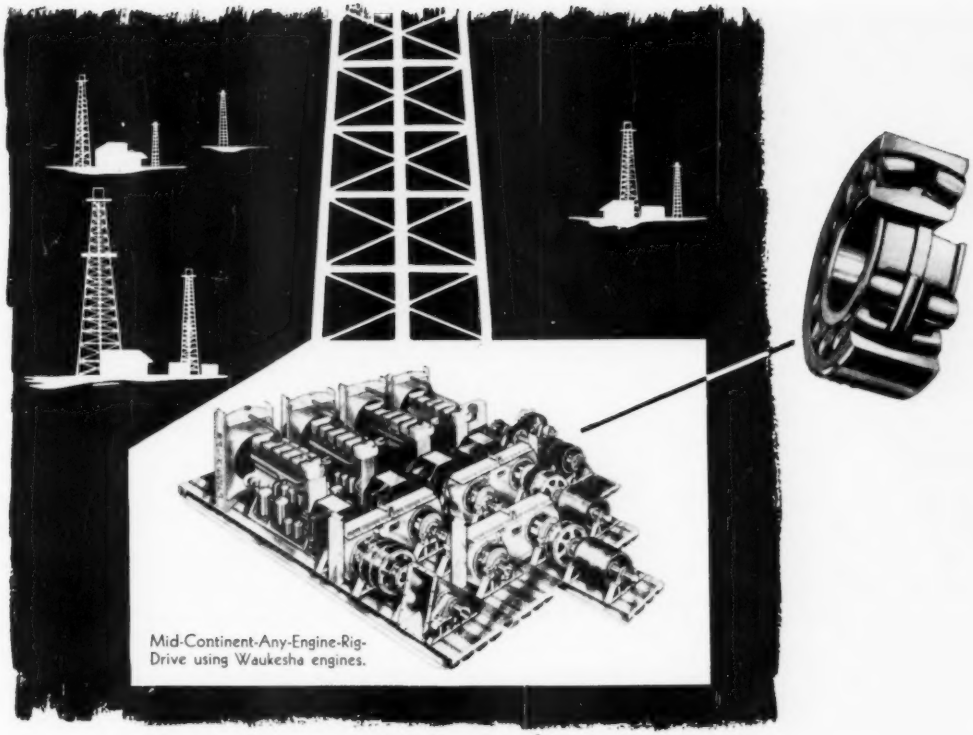
***FREE BOOKLET* tells the simple story of Alcoa Pipe-line Protection**

In ten minutes reading time, Alcoa's new 8-page booklet tells the exceptional economy of an Alcoa buried anode system for pipe-line protection. Your nearby Alcoa sales office will gladly supply sufficient copies for your organization.

MAGNESIUM

ANODES by ALCOA

ALCOA
ALUMINUM



The rig drive for any engine runs more efficiently on SKF Bearings

The new Mid-Continent-Any-Engine-Rig-Drive is so flexible that it permits use of any standard gas or Diesel engine with any draw works. To assure efficient operation and minimum operator attention, Mid-Continent Supply Company engineers specified SKF Bearings: 24 on the four engine drive; 36 on the six engine drive.

Oil field equipment manufacturers are finding that the use of SKF Spherical Roller Bearings on compound drives and transmissions is paying off in longer sustained operation of equipment with greater economy. That's because these bearings accurately locate various shafts, and the self-aligning feature eliminates binding.

Our engineers can show you how to apply SKF Ball and Roller Bearings successfully to your equipment. Call or write: SKF Industries, Inc., Philadelphia 32, Pa. 6605

Oil field Equipment Bearings engineered by SKF

"AVIATION OR REGULAR, COLONEL?"

Leg-power is all the "colonel" needs to breeze down the road or take off into the wild blue yonder of his imagination. But we grown-ups need gasoline to go places . . . nearly a billion barrels a year!

Meeting this huge demand is a big job for the oil industry. And at almost every step it calls for chemicals, many of which DIAMOND ALKALI provides. One of the latest developments is the use of DIAMOND Bichromates to retard corrosion, a deadly enemy of oil equipment. Another enemy, fire, is snuffed out with the aid of Bicarbonate of Soda. In drilling, Soda Ash and Caustic Soda help condition drilling muds, which lubricate drill bits and bring rock cuttings to the surface.

An intriguing use in refining: DIAMOND Chlorine chases away the bad breath nature gave to gasoline. And in the "cat-cracking" process, which yields modern high test fuels, Silicates in synthetic catalysts help urge oil molecules into the proper mood for change.

Here again are reasons why DIAMOND products are *Chemicals You Live By*.

THIS ADVERTISEMENT is one of a series appearing in Time and Newsweek to broaden public understanding of the part DIAMOND ALKALI chemicals play in everyday life. We welcome your inquiry regarding the chemicals and service we provide to the oil industry.

DIAMOND ALKALI CHEMICALS

Chemicals you live by

DIAMOND ALKALI COMPANY... CLEVELAND 14, OHIO

SODA ASH • CAUSTIC SODA • CHLORINE & DERIVATIVES • BICARBONATE OF SODA • SILICATES • CALCIUM COMPOUNDS • CHROME COMPOUNDS • ALKALI SPECIALTIES

BWH
DEPENDABLE RUGGEDNESS
BOSTON WOVEN HOSE & RUBBER CO.
CONCORD
STEAM #10
BOSTON, MASS.
BWH
1. Tough, long-wearing, abrasion-resistant cover.
2. Asbestos braid insures maximum cover adhesion, and includes NEW type static conducting wire.
3. High-tensile steel wire for strength, for safety.
4. Heat & oil resistant tube.

BWH WIRE BRAID STEAM HOSE CAN REALLY "TAKE IT"

HERE'S PROOF!

To prove conclusively that our new Concord #10 Steam Hose is the last word in sturdiness, we deliberately ran a 30-ton truck over it. What happened? Nothing, except that the hose kept right on with its efficient, trouble-free performance!

Naturally, we don't recommend such treatment. But it's pretty convincing evidence that this hose can stand up under all operating hardships. Tests show it doesn't get stiff and brittle, handles easily, resists scuffing when banged against machinery and rough surfaces. Here's why this hose is outstanding:

1. Has same dependably strong, heat and oil resistant tube that has won fame for extra service in BULL DOG Steam Hose.
2. Braids of high-tensile steel wire make it heat and pressure resistant.
3. Asbestos braid assures perfect cover adhesion, includes NEW static-conducting wire.
4. Tough cover is specially designed to resist abrasion, high temperatures.

Specify the NEW Concord #10 when you want hose that withstands 200 lbs. working pressure with SAFETY, cuts maintenance costs.

HAVE YOU A JOB WHERE STAMINA COUNTS?

Bring us your toughest problems. We're specialists in solving them. Consult The Happy Company, Tulsa, Oklahoma.

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Industrial Hose
Rubber Belting
V-Belts
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Power Transmission Equipment

Another Quality Product of

BOSTON WOVEN HOSE & RUBBER COMPANY

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World's Largest Tractors

HANDLE PIPE-LAYING WITH NEW EASE AND SPEED

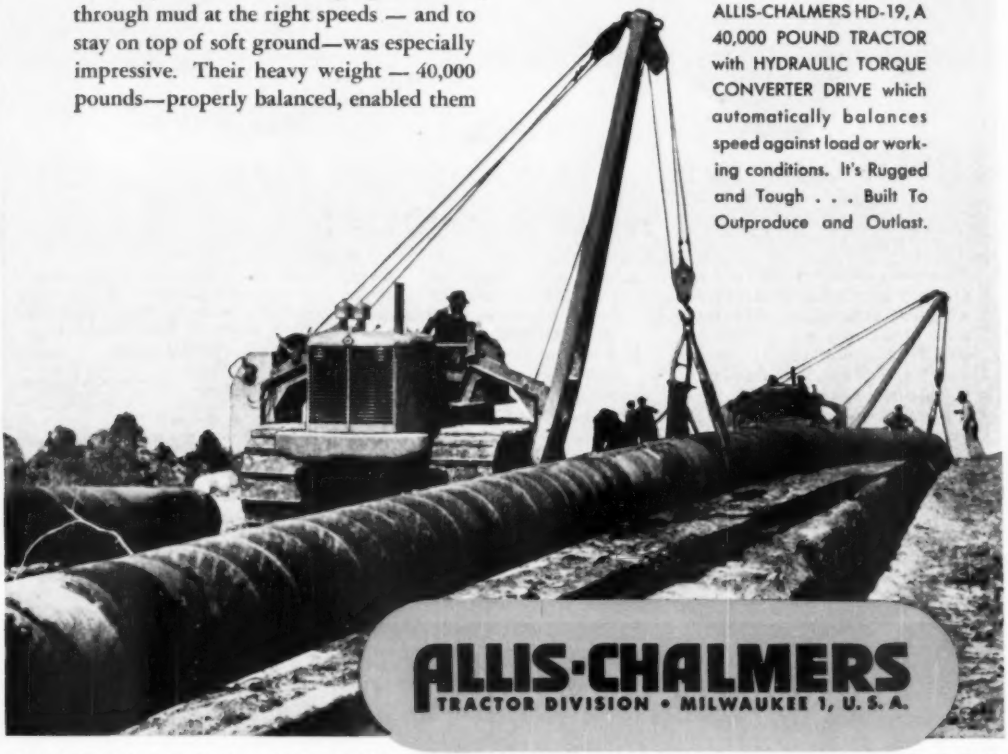
The great lifting capacity, flotation ability and ease of handling of Allis-Chalmers HD-19 Torque Converter Tractors won the admiration of everyone on the Tennessee Gas Transmission Company pipe-laying job near Monroe, Louisiana.

Two of 'em teamed up on this operation — handled both "cradling" and the laying of the 26" pipe, doing the work of three or four conventional tractors.

Ability to travel over rough ground and through mud at the right speeds — and to stay on top of soft ground—was especially impressive. Their heavy weight — 40,000 pounds—properly balanced, enabled them to work with the boom low . . . thus stay ten to twelve feet from edge of trench, preventing cave-ins.

You can also handle your pipe-laying, or any other lifting or grading work with a new ease and speed with the HD-19 — the completely new tractor that gives you a completely new kind of performance. Get the facts from your Allis-Chalmers dealer.

ALLIS-CHALMERS HD-19, A 40,000 POUND TRACTOR with HYDRAULIC TORQUE CONVERTER DRIVE which automatically balances speed against load or working conditions. It's Rugged and Tough . . . Built To Outproduce and Outlast.

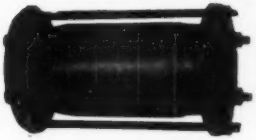


ALLIS-CHALMERS
TRACTOR DIVISION • MILWAUKEE 1, U. S. A.

ORIGINATOR OF THE TORQUE CONVERTER TRACTOR

Convenient!

you can buy these products through these Companies



DRESSER LONG SLEEVES

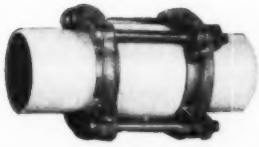
(Style 40) simplify pipe joining. Span gaps between pipe ends. No threading, exact fitting or aligning. Ideal joint at wells, separators, pumps, engines and tanks.

DRESSER COUPLINGS

(Style 38) speed laying of field, gathering and transmission lines; save time on hookups; absorb vibration at pumps, engines and compressors. 100% salvageable in relocating temporary lines.

DRESSER SPLIT REPAIR CLAMPS

(Style 798) for quick repair of pitholes and longitudinal splits in pipe. Furnished with either one or two shells—an inexpensive "bandage" which saves cutting out short sections of damaged pipe.



DRESSER COLLAR CLAMPS

(Style 4,41) stop leaks through threads of screw collars, without service interruption. Band Clamps (Style 77B), Porous Weld Clamps (Style 55), and other pipe repair devices also available.

(Partial List)

Alamo Iron Works
American Pipe & Supply Co.
American Supply Co.
Arrow Supply Co., Inc.
Banks-Miller Supply Co.
Bethlehem Supply Co.
F. W. Black
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Brown-Strauss Corp.
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Capitol City Supply Co.
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Continental Supply Co.
Crane Co.
Donigan Tool & Supply Co., Inc.
Federal Oil Field Supply Co.
Federal Supply & Machine Co., Inc.
Franklin Supply Co.
French Tool & Supply Co.
Frick & Lindsay Company
General Oil Field Supply Co., Inc.
Greenhead Bit & Supply Co.
Gr.anell Co.
Houston Oil Field Material Co., Inc.
Howard Supply Co.
Industrial Supply Co.
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Parkersburg Rig & Reel Co.
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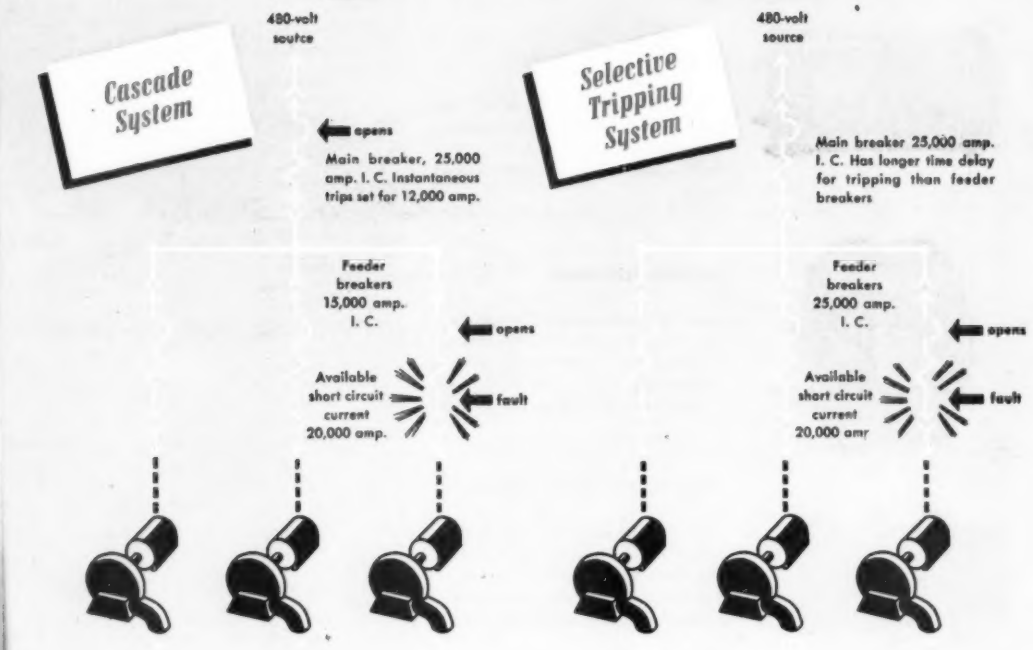
Always within "hollering distance"

at your nearest oil field supply store or our Houston Warehouse, Dresser products save installation time and give you *reliable* connections and repairs.

DRESSER COUPLINGS and Repair Products

Dresser Manufacturing Division (One of the Dresser Industries), 59 Fisher Ave., Bradford, Pa. • Houston Office & Warehouse: 1121 Rothwell Street, Houston, Texas. • Sales Offices: New York, Chicago, Houston, San Francisco.

What's the trend in refinery electrification? } ...better


Cascade System
480-volt source
opens
Main breaker, 25,000 amp. I. C. Instantaneous trips set for 12,000 amp.
Feeder breakers 15,000 amp. I. C.
opens
Available short circuit current 20,000 amp.
fault
Selective Tripping System
480-volt source
Main breaker 25,000 amp. I. C. Has longer time delay for tripping than feeder breakers
Feeder breakers 25,000 amp. I. C.
opens
Available short circuit current 20,000 amp
fault

Cascade system is used where service continuity is not a "must." Here the main air circuit breaker is used to assist the feeder breaker to interrupt all faults over 80 per cent of feeder breaker's capacity. Lesser fault currents are interrupted by the feeder breaker alone.

Selective tripping system lets feeder air circuit breakers interrupt *all* fault currents on feeders. Main air circuit breaker opens only for bus faults or because of failure of feeder breaker. Thus, a short circuit in one feeder does not interrupt power to other feeders.

Here's what you need to modernize your power system! }

WHEN YOU COME TO GENERAL ELECTRIC you get far more than the finest in electrical equipment. A General Electric application engineer, familiar with refinery practices, is at your disposal. If desired, he stands ready to take over the job of co-ordinating all the needed components, engineering your power distribution into one modern, efficient system.

protection against shutdowns

WITH SELECTIVE TRIPPING

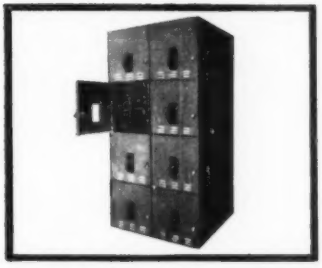
—to isolate faults on low-voltage circuits

Although comparatively new, selective tripping of air circuit breakers is becoming increasingly important in the field of low-voltage power distribution. Especially is this the case in applications—such as continuous processing in refineries—that require a high degree of service continuity. By isolating faults at remote points without tripping the main supply breaker, this method eliminates the costly production delays caused by complete power shutdowns.

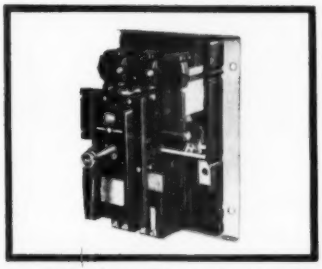
With selective tripping, full interrupting-rating breakers are used throughout, with differently-timed tripping ranges arranged so that the breaker farthest from the power source trips first. Thus, only that portion of the circuit nearest the fault is isolated. The rest of the power system stays in operation, permits uninterrupted production elsewhere in the plant.

For complete information on this new and cost-saving way of protecting your important low-voltage circuits, write for Bulletin GET-1485 "Selective Operation with Air Circuit Breakers." *Apparatus Dept., General Electric Company, Schenectady 5, N. Y.*

FREE G-E AIDS TO POWER SYSTEM SAVINGS! Here are ideas you can use on how to cut the cost of power distribution—your plant's most critical "materials handling" problem. Offered by General Electric as a service to your industry, they're contained in a full-color sound slidefilm, a factual manual, and a supplementary review booklet. All this is available to you and your organization without charge. Just ask your G-E representative to arrange for a showing of the film "Modern Industrial Power Distribution."



G-E metal-enclosed switchgear, containing air circuit breakers with new trip device, needs less floor space. Features include new rack-out mechanism, improved bus construction.



In the G-E Type AK-1 air circuit breaker (shown here with one trip device removed) you get improved arc interruption, multiple arcing contacts, and interchangeable trip units.

New G-E Type EC-1 tripping device for AK-1 air circuit breakers is sealed to eliminate maintenance, easily adjusted, readily removable for changing trip characteristics.

GENERAL ELECTRIC

661-4

How TIMKEN® bearings help keep a pump in its prime

DESIGNED for pumping oil through long pipelines, this Gaso piston power pump has a maximum capacity of 1003 barrels per hour. To help keep this rugged pump operating efficiently for years, Gaso engineers have mounted the crankshaft on Timken® tapered roller bearings.

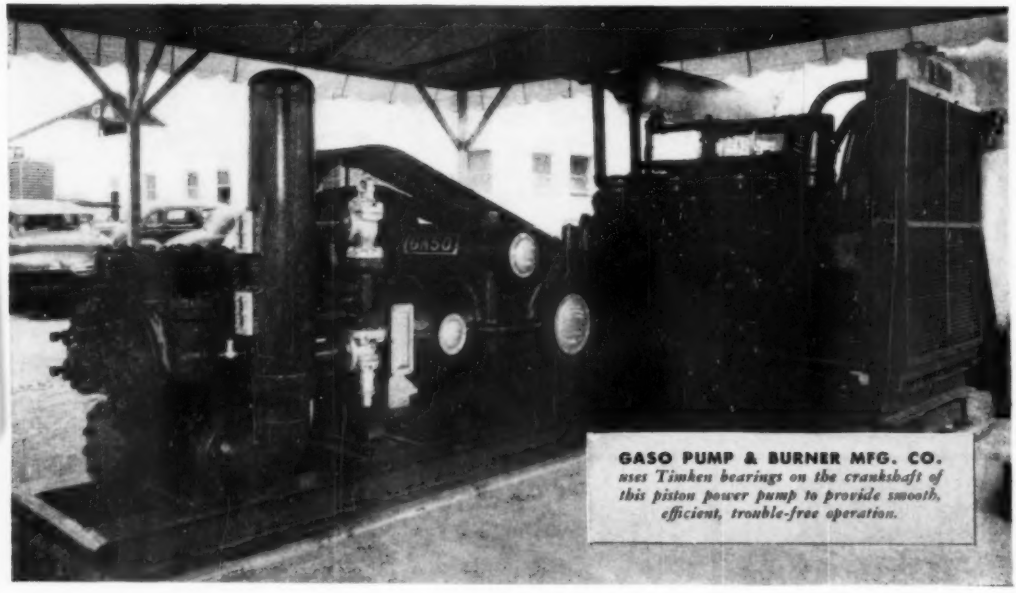
Thanks to their true rolling motion and precision surface finish, Timken bearings minimize friction. They keep the crankshaft in proper alignment so that main and pinion gears mesh more smoothly, last longer. And they eliminate crankshaft wear.

Timken bearings take the heavy loads in their stride. Line contact between rolls and races gives the bearings extra load carrying capacity. And due to their tapered design, they take *both* radial and thrust loads in any combination. No special thrust bearings or washers needed. Designs can be simplified. Space saved.

Timken is the only bearing manufacturer in the country that makes its own steel. As a result, the uniform high quality of Timken bearings can be controlled from the melting of the steel right through to final bearing inspection.

No other bearing can give you *all* the advantages you get with Timken tapered roller bearings. Be sure to look for the trade-mark "Timken" on the bearings. The Timken Roller Bearing Company, Canton 6, Ohio. Cable address: "TIMROSCO".

This symbol on a product means its bearings are the best.



GASO PUMP & BURNER MFG. CO. *uses Timken bearings on the crankshaft of this piston power pump to provide smooth, efficient, trouble-free operation.*

FINISHED TO CLOSER TOLERANCES

Finishing to incredible smoothness accounts for much of the precise, smooth rolling performance of Timken bearings. This honing operation is typical of the amazingly accurate manufacturing methods at Timken.

The Timken Company is the acknowledged leader in: 1. advanced design; 2. precision manufacturing; 3. rigid quality control; 4. special analysis steels.

TIMKEN

TRADE MARK REG. U. S. PAT. OFF.

TAPERED ROLLER BEARINGS

TIMKEN 1899 50 YEARS 1949

NOT JUST A BALL ◯ NOT JUST A ROLLER ▭ THE TIMKEN TAPERED ROLLER ▭ BEARING TAKES RADIAL ▯ AND THRUST ▯ LOADS OR ANY COMBINATION

MIDWEST WELDING FITTINGS
Improve Piping Designs and Reduce Costs

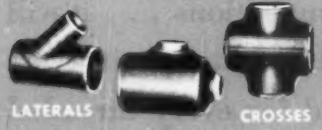
90° ELBOWS

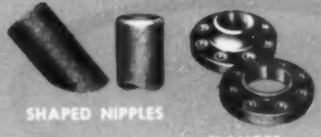
REDUCING 90° ELBOWS
45° ELBOWS

LAP-JOINT STUB ENDS
REDUCERS

CAPS
SADDLES
SLEEVES

RETURN BENDS
TEES


LATERALS
CROSSES
REDUCING-ON-RUN TEES

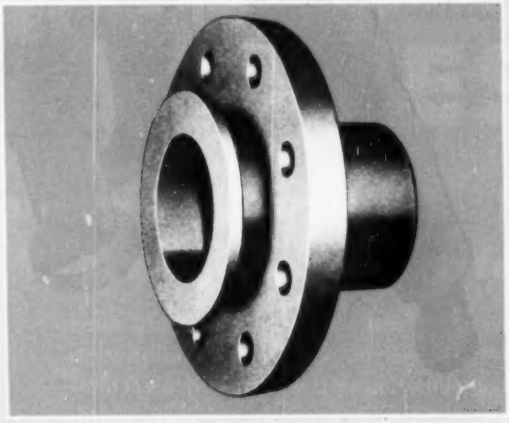

SHAPED NIPPLES
FLANGES

IN WELDED PIPING SYSTEMS

SAVE TIME and MONEY on EQUIPMENT CONNECTIONS

by using MIDWEST

LAP JOINT STUB ENDS



Substantial savings of time and money result if Midwest Lap Joint Stub Ends are used when making connections to valves, equipment or other flanged outlets in welded piping systems. They have important advantages over flanges welded to the pipe.

The swivel flange makes it unnecessary to line up the bolt holes before welding. Setting up is quick and simple because no special clamps or jigs are required to hold the face of the flange absolutely perpendicular to the axis of the pipe. Field crews report as high as 25% saving in erection time for making up a joint using Midwest Lap Joint Stub Ends in comparison with rigidly fixed flanges.

Midwest Welding Fittings improve piping—save money. Get in touch with the distributor near you.

3719

MIDWEST PIPING & SUPPLY COMPANY, Inc.

Main Offices: 1450 South Second Street, St. Louis (4), Mo.
***Sales Offices:* New York (7), 30 Church St.**
Chicago (3), 79 West Monroe St. • Los Angeles (33), 520 Anderson St. • Houston (2), 229 Shell Bldg. • Tulsa (3), 533 Mayo Bldg. • South Boston (27), 426 First St. • Distributors in Principal Cities.

Save the threads and you save your pipe . . . use a THREDKOTE Compound on all threaded connections . . . it will give you 3-point service . . . 1, it seals; 2, it lubricates; 3, it's rust preventive . . . there's a Thredkote Compound for every threaded joint in the oil industry.

Thredkote 701 for extreme pressure connections, oil well casing and tubing, tool joints.
Thredkote 702 for Christmas Tree assemblies, steam lines.
Thredkote 705 for extreme and high pressure connections.
Thredkote 708 for air lines, bolted tanks, gas and gasoline lines, gasket seals, oil well casing and tubing, permanent sealer.

THREDKOTE
REGISTERED U. S. PAT. OFF.

For sale by Humble Oil & Refining Co., and leading oil industry supply houses.

EATON
2-Speed Truck
AXLES

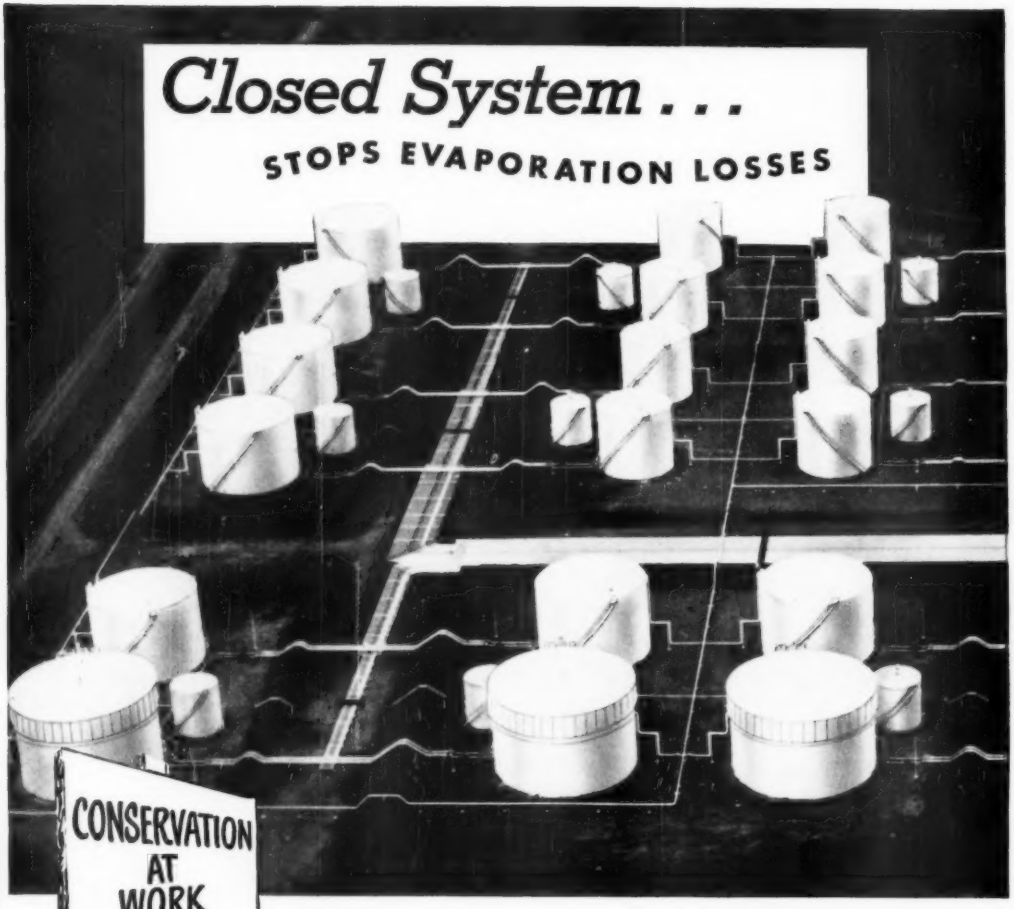
Last Longer because Moving Parts are Always Thoroughly Lubricated

More Than a Million Eaton 2-Speed Axles in Trucks Today

Eaton's exclusive forced-flow lubrication system starts oil on its way to all moving parts the instant the axle turns over. This protection to gears at low truck speeds, as well as high, reduces friction and wear on moving parts, adds thousands of miles of trouble-free life to Eaton 2-Speed Axles. Your truck dealer will be glad to explain how Eaton Axles contribute to lower operating and upkeep costs by embodying a balanced combination of pulling power and speed on most trucks of the 1½-ton class and larger.

Axle Division
EATON MANUFACTURING COMPANY
CLEVELAND, OHIO

PRODUCTS: SODIUM COOLED, POPPET, AND FREE VALVES • TAPPETS • HYDRAULIC VALVE LIFTERS • VALVE SEAT INSERTS • ROTOR PUMPS • MOTOR TRUCK AXLES • PERMANENT MOLD GRAY IRON CASTINGS • HEATER-DEFROSTER UNITS • SNAP RINGS • SPRINGTITE SPRING WASHERS • COLD DRAWN STEEL • STAMPINGS • LEAF AND COIL SPRINGS • DYNAMATIC DRIVES, BRAKES, DYNAMOMETERS



WITH

GRAVER EXPANSION ROOF TANKS

● Here's a products pipe line terminal where three Graver Expansion Roofs provide the capacity to conserve the vapors in a 27 tank system. *All* the capacity of *all* the equipment is employed, because no venting can occur until all Expansion Roofs reach their maximum height.

Graver Expansion Roofs effectively prevent all breathing or standing losses; and when vapor volumes are balanced during filling and emptying operations, they also eliminate filling losses. In addition, Graver Expansion Roofs offer the advantages of simplicity of design, ease and accuracy of gauging, low maintenance costs, and perfect roof drainage.

Whether it's a single or multiple installation, the Graver Expansion Roof gives you *complete* conservation. Make sure your savings are complete in every respect. Write for facts and figures in full detail . . . today.

GRAVER

FABRICATED PLATE DIVISION

GRAVER TANK & MFG. CO., INC.

EAST CHICAGO, INDIANA

NEW YORK • PHILADELPHIA • CHICAGO • CATASAUQUA, PA. • HOUSTON • SAND SPRINGS, OKLA.

replacements are far less frequent when you use

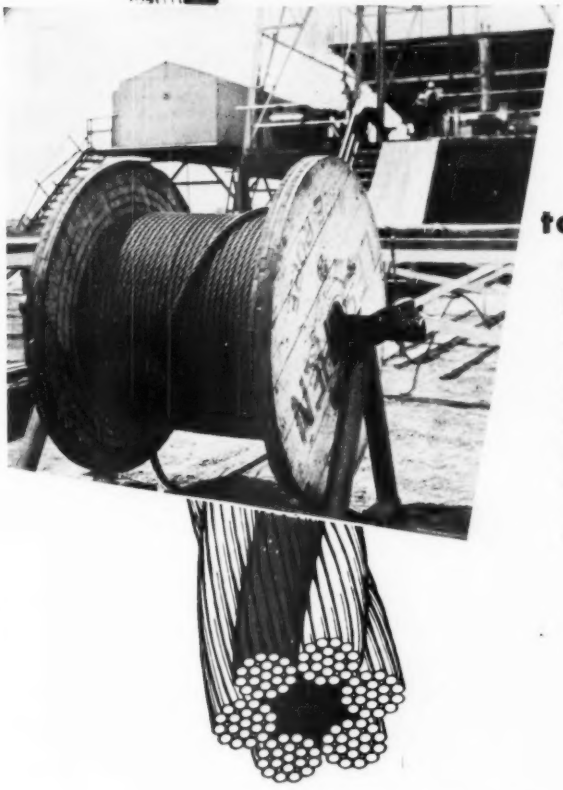
-Preformed-

"HERCULES"

REG. U.S. PAT. OFF.

RED-STRAND

WIRE ROPE



because–

Its strength...its toughness...its unusual endurance–add up to longer wire rope life

These essential life factors are not a matter of chance. They are the result of combining "HERCULES" quality and PREFORMING. This is a winning combination as Preforming is the process that increases the life of a wire rope, by freeing it of internal stresses. It also makes a wire rope easier, quicker and safer to handle.

"HERCULES"
RED-STRAND
the DEPENDABLE
WIRE ROPE
for any TOUGH JOB

MADE ONLY BY

A. LESCHEN & SONS ROPE CO.

ESTABLISHED 1857

5909 KENNERLY AVENUE • ST. LOUIS 12, MISSOURI

NEW YORK 6 • CHICAGO 7 • HOUSTON 3 • DENVER 2
LOS ANGELES 21 SAN FRANCISCO 7 PORTLAND 9 SEATTLE 4

More-for-your-money...

DODGE "Job-Rated" TRUCKS

PRICED WITH THE LOWEST!

NEW B-2 series

NEW Dodge B-2 Series Chassis Features

1. SUPER-FRICTION CLUTCHES. Large frictional areas. "Job-Rated" for smooth action and long life.

2. RUGGED 3-, 4- or 5-SPEED SYNCHRO-SHIFT TRANSMISSIONS — "Job-Rated" for the load. Carburized gears; heat-treated shafts; antifriction bearings throughout.

3. FULL-FLOATING REAR AXLES . . . Hypoid design; banjo-type housing . . . "Job-Rated" for the load. Long life . . . low upkeep cost.

4. CYCLEBONDED brake linings (no rivets) prolong brake life.

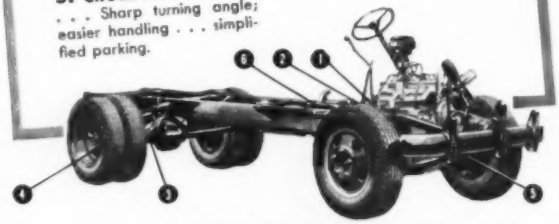
5. CROSS-TYPE STEERING . . . Sharp turning angle; easier handling . . . simplified parking.

6. SAFETY-LOCATED GAS TANKS . . . Outside the cab, NOT inside!

• • •

NEW STEERING COLUMN GEARSHIFT . . . Standard equipment on ½-, ¾- and 1-ton models with 3-speed transmissions . . . provides easier handling, more unobstructed floor space, greater safety of operation.

"RIGHT-SPOT" HAND BRAKE . . . under the center of the cowl . . . *right where you want it.* Standard on all ½-, ¾- and 1-ton models. Provides unobstructed floor space; easier passage through either cab door.



THEY'RE more-for-your-money any way you look at them!

Read why . . . on this page. *See* why . . . at your Dodge dealer's.

New B-2 Series Dodge *"Job-Rated"* trucks are designed throughout to last longer . . . to save you money!

Compare them—feature for feature, price for price, value for value—with any other trucks! Know what you're getting for what you pay.

Switch to Dodge. See your Dodge dealer . . . now . . . and *save money!*

NEW Dodge B-2 Series Engine Features

- **FAMOUS DODGE L-HEAD TRUCK ENGINES** . . . "Job-Rated" for your loads. Save gas, oil—cut service expense.
- **COMPLETELY SPLASH- AND DUST-PROOF ELECTRICAL SYSTEM** . . . with high-output generator. Resistor-type spark plugs, and high-output coil, provide amazingly smooth engine operation; insure longer plug life.
- **EXHAUST VALVE SEAT INSERTS** . . . resist wear, pitting. Reduce valve grinding; preserve performance.
- **REPLACEABLE PREFITTED MAIN BEARINGS** . . . precision, long-life quality. Reduce maintenance costs.
- **FULL-LENGTH CYLINDER COOLING** . . . uniform cooling of cylinders, protects . . . reduces wear.
- **4-RING ALUMINUM ALLOY PISTONS** . . . for top performance; longer bearing life; low oil consumption.
- **FULL-PRESSURE LUBRICATION** . . . positive pressure to main, connecting rod and camshaft bearings and camshaft drive; prolongs engine life.
- **OIL-BATH AIR CLEANER** . . . highly effective in protecting the engine from dust and dirt.

356 BASIC CHASSIS MODELS, RANGING FROM 4,250 TO 23,000 LBS., G.V.W.

Continuous PIPELINE Service

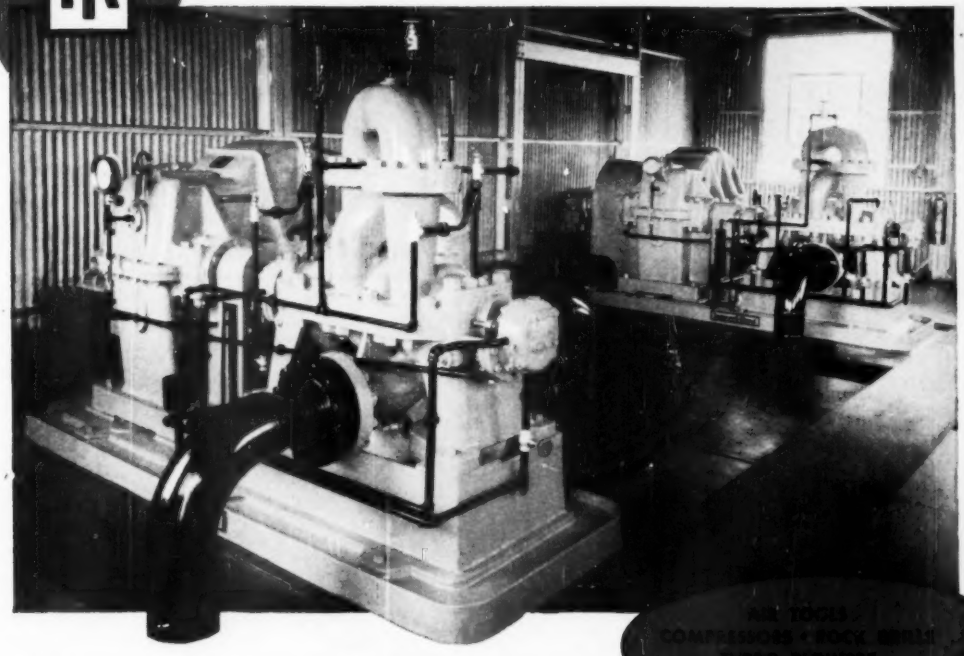
The movement of petroleum through the nation's pipelines is a 24 hour-a-day job—day after day, week after week—thousands of barrels per hour, millions of barrels per week.

Ingersoll-Rand has specialized in pumps for this exacting service for many years. Class RT multi-stage units and class BHV single-stage units are installed on pipelines not only in this country but also in many foreign oil fields.

Class RT and BHV pipeline pumps include all mechanical and hydraulic features that make for reliable operation—heavy duty bearings, balanced impellers, heat treated steel shafts protected throughout by intermediate sleeves and impellers—and other important features too numerous to mention.

All Ingersoll-Rand pipeline pumps can be equipped with the famous I-R Cameron Shaft-Seal, which replaces the packing in the stuffing box and practically eliminates any stuffing-box maintenance.

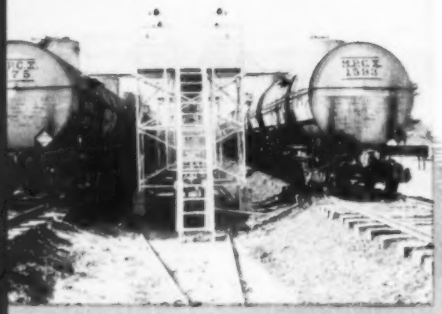
Contact an I-R engineer. He will be glad to give you the full details on our pipeline pumps and the Cameron Shaft-Seal.



AIR TOOLS
COMPRESSORS • ROCK DRILLS
TURBO BLOWERS
CONDENSERS
CENTRIFUGAL PUMPS
OIL & GAS ENGINES

Ingersoll-Rand

CAMERON PUMP DIVISION 97-10
11 BROADWAY, NEW YORK 4, N. Y.



BS&B-API double track loading rack . . . one of eight standard types built entirely of all steel BS&B SAFWALK material.

Use Versatile SAFWALK

BS&B SAFWALK stairway and walkway . . . note the efficient truss bracing on both the walkway and the stairway, and the diagonal braces which make the structure strong and rigid.

BS&B SAFWALK platform used for Sullivan Head. The blister burred holes on all walking surfaces is an added safety feature.

All parts of any equipment can be made easily accessible with structures made of BS&B SAFWALK material.

for every job . . .

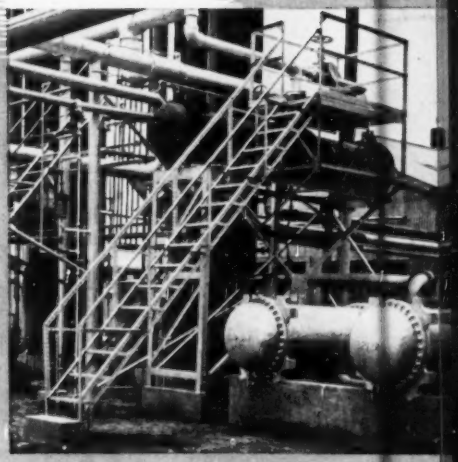
Small or Large

For versatility in structural material, there is nothing like BS&B SAFWALK.

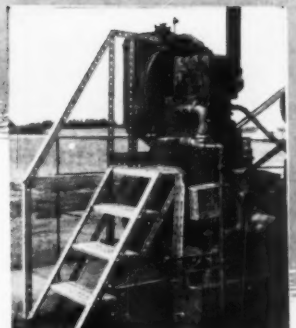
For loading racks, platforms, stairways, storage bins, floors, supporting beams . . . for indoor structures or outdoor structures, in fact, you can use SAFWALK virtually anywhere that strong structures of permanent or semi-permanent nature are required. Similar to a giant erector-set, BS&B SAFWALK material is easily carpentered in the field to the particular job on hand. After it has served its purpose, it can be taken down, then re-erected for the same or for an entirely different application.

The all-steel construction of SAFWALK material makes it absolutely fireproof. Structures are strong, rigid, and safe . . . the blister burred holes punched in all walking surfaces, make it practically accident-proof in any weather.

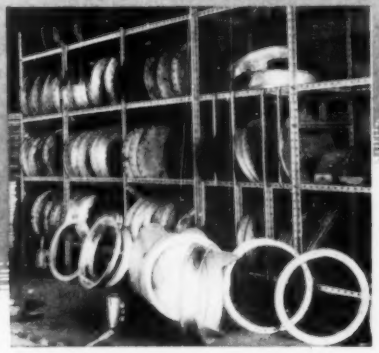
See your BS&B dealer today, or for more information write to Oil Field Equipment Division, Black, Sivalls & Bryson, Inc., Kansas City, Missouri.



A refinery platform made entirely of SAFWALK material. The all steel construction makes it absolutely fireproof.



Pumping unit platform and stairway . . . permit lubrication and service work with a maximum protection for the workmen.



Warehouse storage racks . . . the versatility of the material makes it adaptable for almost any type of structure.

A modern grandstand built of standard SAFWALK material. This grandstand is 250 feet long with twenty rows of seats.

BLACK, SIVALLS & BRYSON, INC.

KANSAS CITY, MISSOURI **OKLAHOMA CITY, OKLAHOMA**

GULF TANKERS
go 18 months between overhauls with
KOPPERS PISTON RINGS

ROMANCE, RESCUE and 'BLACK GOLD'
GULF OIL TANKERS COMBINE ALL IN A DAY'S WORK!
S O S
IN THE TROPICS AT PUERTO LA CRUZ, VENEZUELA, THE GIANT TANKER, GULFPRIDE, LOADS HER PRECIOUS CARGO OF "BLACK GOLD" FOR THE REFINERY IN PHILADELPHIA, 2300 MILES AWAY.
THREE DAYS OUT, AND PLOWING NORTH WITH 6½ MILLION GALLONS OF OIL IN HER TANKS, THE TANKER PICKS UP A FRANTIC S.O.S., CHANGES COURSE AND FULL SPEED AHEAD.
HARD RIGHT RUDDER, SLOW AHEAD. STAND BY TO LOWER STARBOARD LIFE BOATS
HER 2500 H.P. DIESEL ENGINES WORKING AT PEAK POWER PUSH THE 20,000 TON SHIP AT TOP SPEED. THE SURVIVORS ARE SIGHTED!
A LIFE BOAT IS SENT OVER, AND A DANGEROUS SEA RESCUE IS EFFECTED. GRATEFUL SURVIVORS ARE GIVEN HOT DRINKS AND MEDICAL ATTENTION...AND THE GREAT TANKER IS ON HER WAY AGAIN, NO TIME FOR PLAUDITS.
DESPITE TIME TAKEN IN THE RESCUE, SHIP ARRIVES ON TIME AND HER DIESEL-DRIVEN PUMPS DISCHARGE THE OIL AT THE RATE OF 200,000 GALLONS AN HOUR.
THE GULFPRIDE'S CHIEF ENGINEER SAYS:
OUR SCHEDULES DEMAND CONTINUOUS ROUND TRIPS FROM THE TROPICS TO THE NORTH WITH 18 MONTHS BETWEEN OVERHAULS. THAT'S WHY WE SPECIFY KOPPERS PISTON RINGS IN ALL OUR DIESELS

KOPPERS PISTON RINGS have won their reputation the hard way . . . in the tough service of ocean-going tankers and tugs, high-speed streamliners, overloaded pumping engines.

Where dependability and economy are essential, you'll find engine builders and operators specifying Koppers American Hammered Rings. The reason for their superlative performance is simple. They embody the two greatest developments in piston rings . . . Porous Chrome* and K-Spun.

Take a look at the important features listed at the right. Then take a step toward longer ring life and better service. Check with Koppers engineers now. Koppers Company, Inc., Piston Ring Dept., Box 626, Baltimore 3, Maryland.

*VAN DER HORST PROCESS

WHAT POROUS CHROME PLATING AND K-SPUN METAL MEAN TO YOU

1. Guaranteed against ring breakage. Tensile strength double ordinary gray iron castings.
2. All rings seat immediately without scuffing and scoring.
3. Ring and cylinder wear greatly reduced.
4. Fifty percent more elasticity retains shape and tension far longer.
5. Four times greater impact strength means long life in severe service.

KOPPERS

American Hammered

KOPPERS PISTON RINGS

Dependability, Efficiency and Long Life proved by years of *PIPE-LINE Performance*

IMMEDIATE DELIVERY

An "Oilwell"—Wilson-Snyder No. 14P-HD (7¼"x14") Pipe-Line Pump in service in West Texas.

"OILWELL"—WILSON-SNYDER

Pipe-Line Pumps

STURDILY built "Oilwell"—Wilson-Snyder Pumps of the following range of sizes are available at all "Oilwell" stock points.

Pipe-Line Pumps	Max. Liner Sizes - Inches (Bore x Stroke)	Rated Speed RPM	Maximum Pressure PSI	Recommended Input HP	*Gallons per Minute	*Barrels per Hour	*Barrels per Day
6P-HD	4 x 6	100	455	40	126	180	4320
8P-HD	5 x 8	80	600	85	205	293	7032
12-P	5 x 12	70	540	100	270	386	9264
12P-LD	6 x 12	70	365	100	395	564	13536
612-P	6 x 12	70	520	140	390	557	13368
712-P	7¼ x 12	70	550	220	580	828	19872
14P-HD	7¼ x 14	65	765	325	620	885	21240

*Theoretical with piston rod deducted.

Above listed pumps are stock sizes. Special pumps can be furnished to meet individual requirements.

Built to perform outdoors, "Oilwell"—Wilson-Snyder Pumps are designed to give continuous service despite weather conditions.

Call your nearest "Oilwell" representative for complete specifications, and let him assist you in selecting the equipment for your particular pipe-line needs.

OIL WELL SUPPLY COMPANY

Branches Serving All Oil Fields

Executive Offices—DALLAS, TEXAS
Export Division Office—
30 ROCKEFELLER PLAZA
NEW YORK 20, N. Y.

Division Offices—CASPER, WYOMING
COLUMBUS, OHIO . . . DALLAS, TEXAS
HOUSTON, TEXAS . . . TULSA, OKLAHOMA
LOS ANGELES, CALIFORNIA

USS "OILWELL"

UNITED STATES STEEL

Earn BIG SAVINGS on LARGE

KOEHRING CRUISER CRANES give you extra speed, mobility ...ONE-MAN HANDLING

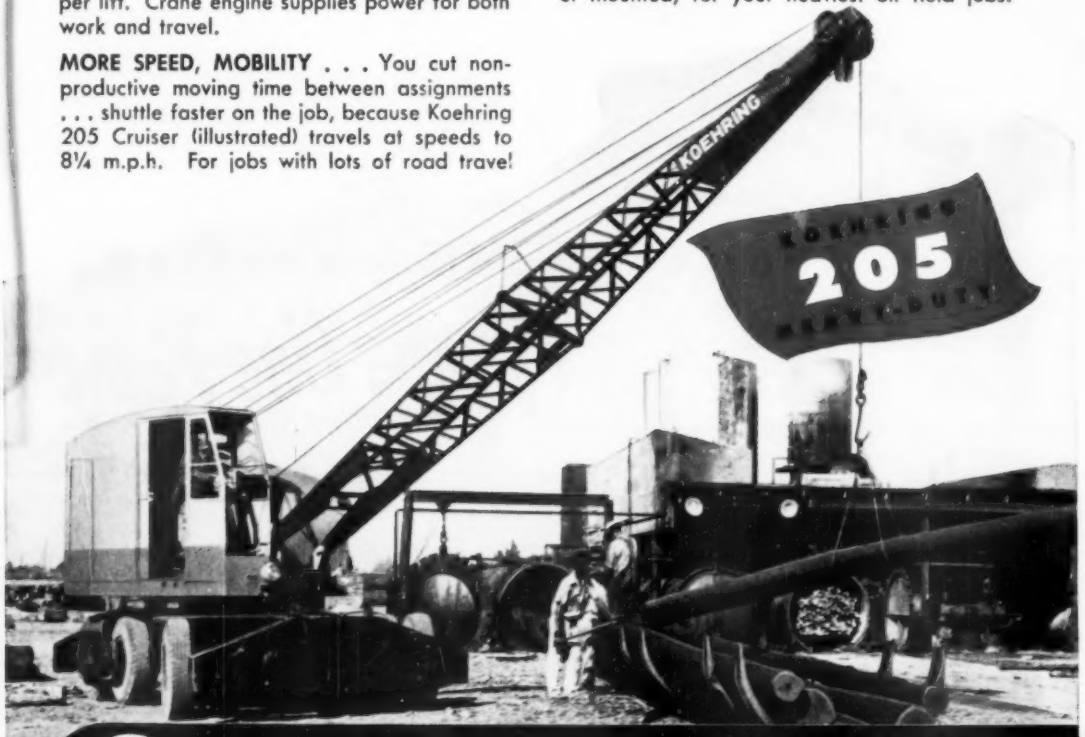
On jobs of short duration, unloading cars, setting steel, handling pipes, tanks, etc. . . . anywhere travel time is an important percentage of job duration, you can earn big savings in time and handling costs with Koehring rubber-tired Cruiser Cranes. You get:

ONE-MAN HANDLING . . . Operator controls both crane work and travel from cab . . . means less man-hours to get job done . . . lower cost per lift. Crane engine supplies power for both work and travel.

MORE SPEED, MOBILITY . . . You cut non-productive moving time between assignments . . . shuttle faster on the job, because Koehring 205 Cruiser (illustrated) travels at speeds to 8¼ m.p.h. For jobs with lots of road travel there is also a truck mounting that gives you 35 m.p.h.

EXTRA LIFT CAPACITY . . . extra stability of rubbed-tired mounting increases 205's maximum lifting capacity from 13,800 lbs. crawler rating to 20,000 lbs. on cruiser mounting. 205 on truck mounting lifting capacity also increases to 20,000 lbs.

That's only a few of the reasons why it pays to use Koehring rubber-tired Cranes, wherever oil field operating conditions permit. Your local Koehring distributor can show you many more time and money-saving advantages. Ask him, too, about bigger Koehring 304, also available on rubber as cruiser or truck. Other Koehring sizes: Big 605 and 1005, both crawler-mounted, for your heaviest oil field jobs.



KOEHRING HEAVY DUTY

KOEHRING COMPANY
Milwaukee 10, Wis.

SUBSIDIARIES: JOHNSON • PARSONS • KWIK-MIX

and SMALL oil-field jobs.....

KWIK-MIX 3½-S.... utility size DANDIE

- Pays off on scattered, small-quantity mixing assignments . . . gives you high-quality concrete mixed fast, at low cost anywhere on your property.
- Portable as a wheelbarrow . . . balanced light weight and handy push-down towpole provide safe one-man handling on the job . . . easy towing.
- Large drum opening, low shoveling height of only 3½' mean fast, easy charging . . . more concrete mixed per shift.
- Convenient end discharge eliminates backing and turning loaded wheelbarrow . . . gets barrow loaded and on its way with ½ the usual effort.

For consistent savings on your major concrete-laying projects, check bigger size Kwik-Mix 6-S . . . 11-S . . . 16-S DANDIES*.

*Trademark Reg. U. S. Pat. Off.

fully-powered Moto-Bug ups output per man-hour...

On your small materials-handling tasks, you can get 3 to 4 times more production per man-hour with Kwik-Mix 4 h.p. Moto-Bug. Here's why. It hauls 4 times as much (10 cu. ft.) as ordinary hand wheelbarrow . . . makes more trips per hour because it's *fully powered*, travels 1½ to 4 m.p.h. forward and reverse. No pushing . . . no pulling . . . no end-of-day "slow-down". For complete facts on its controlled gravity dump . . . positive steer arrangement . . . *standard make* 4-cycle gas engine . . . and 1200 lb. capacity flat-bed platform, see your local Kwik-Mix distributor, or send for bulletin.

KKM923

KWIK-MIX COMPANY
Port Washington, Wis.
KOEHRING SUBSIDIARY

MAIL TODAY

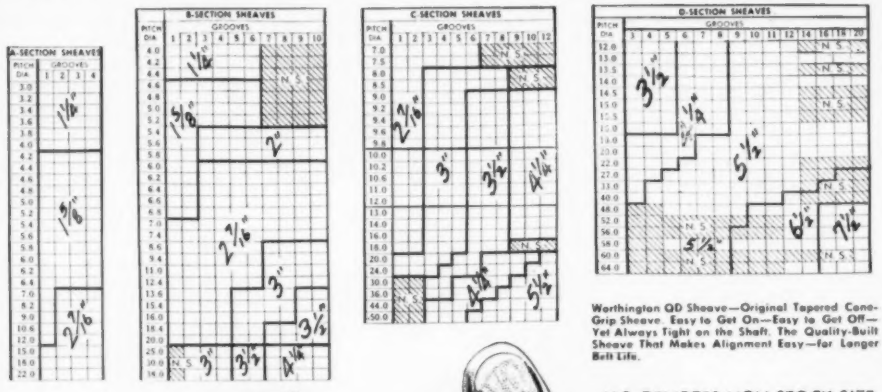
To: KWIK-MIX CO., Dept. OG, Port Washington, Wis.

Please send bulletins on following DANDIE concrete mixers: ☐ 3½-S ☐ 11-S ☐ 6-S ☐ 16-S

NAME.....TITLE.....
COMPANY.....
STREET.....
CITY.....STATE.....
Also send ☐ bulletin ☐ price information on low-cost MOTO-BUG.

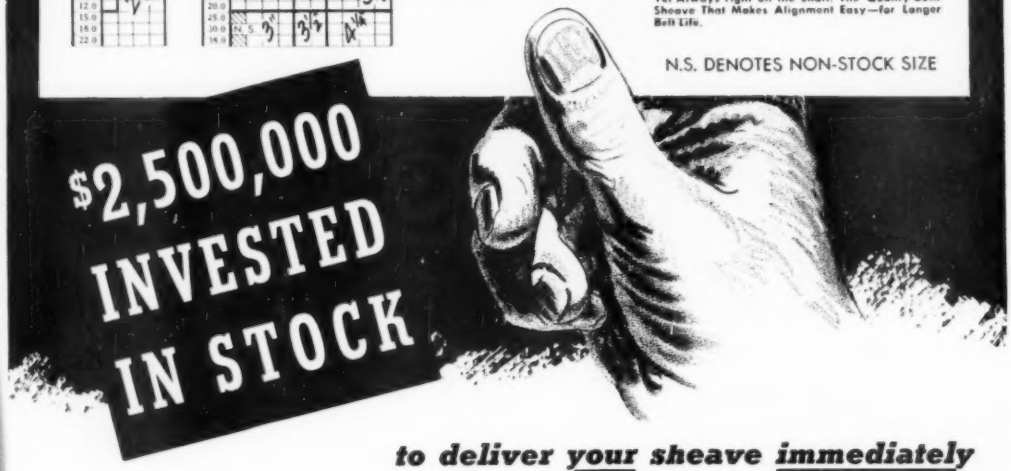
THE GOOD RIGHT HAND OF INDUSTRY

STOCK SIZES WORTHINGTON HEAVY DUTY "QD" SHEAVES WITH MAXIMUM BORES INDICATED



Worthington QD Sheave—Original Tapered Cone-Grip Sheave. Easy to Get On—Easy to Get Off—Yet Always Tight on the Shaft. The Quality-Built Sheave That Makes Alignment Easy—for Longer Belt Life.

N.S. DENOTES NON-STOCK SIZE



to deliver your sheave immediately

As long as it takes our distributor's shipment to get there is as long as it takes—in most cases—to get exactly the sheave you need into your hands. Your Worthington distributor has practically any stock size you'd ever call for—if he hasn't, one of the Worthington warehouses will get it to him in 24 hours or less.

Check your sheave requirements. With more sheaves listed as "stock sizes" and more sizes in stock than any other distributor, your Worthington distributor may be able to save you the cost of a special sheave.

Top-ranking distributors in the oil fields handle Worthington QD Sheaves and Worthington-Goodyear V-belts. They are backed by Worthington warehouses whose stocks duplicate the factory stock at Buffalo—more sizes stocked than any other sheave on the market. With 853 sizes in "A", "B", "C" and "D" section, ½ to 600 hp, you can fill almost any rpm requirement with a *stock* sheave. Also: 332 listed stock sizes of EC Cord V-belts.

So, when you need sheaves, call your local oil-field dealer.

For Balanced Drive Performance

Specify Worthington Multi-V-Drives, with QD Sheaves and Worthington-Goodyear EC Cord V-belts. (Goodyear EC Cord or Steel Cable V-belts are used exclusively in Worthington Multi-V-Drives.)

WORTHINGTON

WORTHINGTON PUMP AND MACHINERY CORPORATION
MULTI-V-DRIVE SALES DIVISION
Buffalo, New York—General Offices: Harrison, New Jersey

The Good Right Hand of Industry

POWER TRANSMISSION: sheaves, V-belts, variable speed drives
PUMPS: centrifugal, power, rotary, steam
AIR COMPRESSORS: water-cooled, air-cooled

MVI92B

PROOF - *not Guesswork*

Makes FWD America's Foremost Heavy-Duty Truck

Here's actual operating proof in oil field service. This FWD electric well logging unit has just come out of a sharp curve on the way to location. Yes — with power on all wheels, FWD Trucks give you the extra traction you need to take tight turns safely. What's more, you can be sure of this even before you buy, because FWD Four and Six Wheel Drive Trucks are scientifically tested on the FWD proving ground to speed over a 100-foot unbanked circle without skidding. *No wonder many of the world's leading oil field operators standardize on FWDs — with individual fleets of over 600 units!*

WHAT FWDs DO ON THE PROVING GROUND
1 Highball over hilly curved roads!
2 Slog thru mud — up to the bumper!
3 Speed over 100-ft. unbanked circle!
4 Twist over ditches — 18 inches deep!
5 Drive up 6% grade thru 3-ft. of sand!
6 Climb 70% grade from dead stop!
7 Climb 8-in. beam from standstill!
8 Drill pole holes to prove equipment!
9 Speed safely over level highways!
1
2
3
4
5
6
7
8
9

This is FWD's proving ground. This is your assurance that the FWD you select has the stamina to insure long life without expensive mechanical breakdowns.

An FWD speeds over the 100-ft. unbanked circle at the proving ground. For all the facts about FWD trucks, see your FWD distributor — or write direct.

An Invitation To Truck Buyers

We invite you to watch FWDs pass a series of rigid performance tests. Ask your FWD distributor to arrange your visit to our plant. Or — if you can't get away, ask him to show you the movie, *The FWD Story*. In either case, you will see for yourself how FWD trucks can help solve your heavy-duty trucking problems.

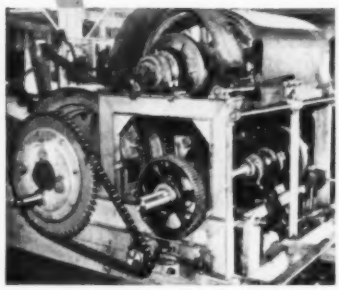
Marion A. Allen
President
The Four Wheel Drive Auto Company

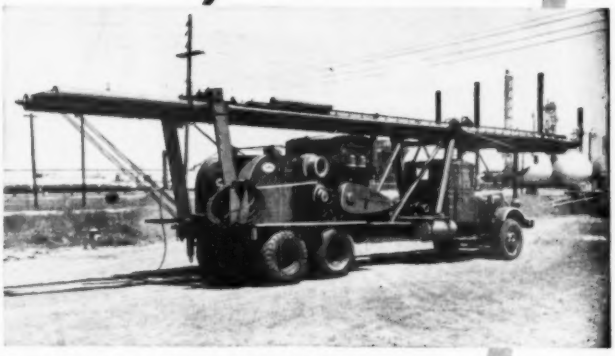
THE FOUR WHEEL DRIVE AUTO COMPANY
Clintonville, Wis. • *Canadian Factory:* Kitchener, Ontario
FOUR AND SIX WHEEL DRIVE TRUCKS

0-1

America's Foremost Heavy-Duty Truck

MORSE Roller Chain *fits the picture*





Morse Roller Chain—flexible, rugged, economical — meets the exacting demands of the best petroleum equipment manufactured. It is used on this truck-mounted 4000′ single drum rotary Wichtex, made by the Wichtex Machinery Company, Wichita Falls, Texas.

ALMOST any petroleum equipment can improve its performance picture by the use of Morse mechanical power transmission products.

Here's just one instance where this is proved. Morse Roller Chain, used by the Wichtex Company in its single and double drum rotary drills, helps to maintain top performance through dependable power transmission.

Petroleum equipment manufacturers choose Morse Roller Chain time and again for their mechanical power drives. They know it will stand up under the gruelling punishment machinery must take in drilling operations. And they know it to be an efficient, flexible drive which gives long, trouble-free service life and low-cost, positive power transmission.

Morse Roller Chain is manufactured in all American Standard pitches and widths. Morse sprockets embody Morse's designing and engineering skill. Mass-production facilities and modern equipment result in accurate quantity production at low cost.

Check on Morse Roller Chain for possible improvement in the mechanical power transmission in your equipment. And remember that replacement chains are immediately available in distributor's stocks near-by. Write for details. Dept. 430, Morse Chain Company, Detroit 8, Michigan.

Morse Marflex Coupling

MORSE

MECHANICAL
POWER TRANSMISSION
PRODUCTS

A PRODUCT OF BW BORG-WARNER

Morse Silent Chain Drives

Morse-Rockford Clutches

Morse-Rockford Pullmore Clutches

MORSE CHAIN COMPANY DETROIT 8, MICHIGAN

BRANCH OFFICE AND WAREHOUSE, 1308 LA BRANCH, HOUSTON, TEXAS

Construction by Graver

KEY TO EFFICIENCY IN A PIPE LINE TERMINAL

A complex piping set-up . . . pump house, valves, controls, pumps . . . is the key to efficient operation of this pipe line terminal.

Petroleum marketers, like refiners and chemical processors, have found the Graver Construction Co. a valuable help where operating efficiency depends on sound engineering and construction practices. Engineering, material procurement and on-the-site erection . . . all these are included in Graver's complete construction service. Organized to work with the petroleum and process industries, it is your assurance of a job well done.

For details on Graver's handling of any job . . . from equipment setting to complete plant construction . . . write today.

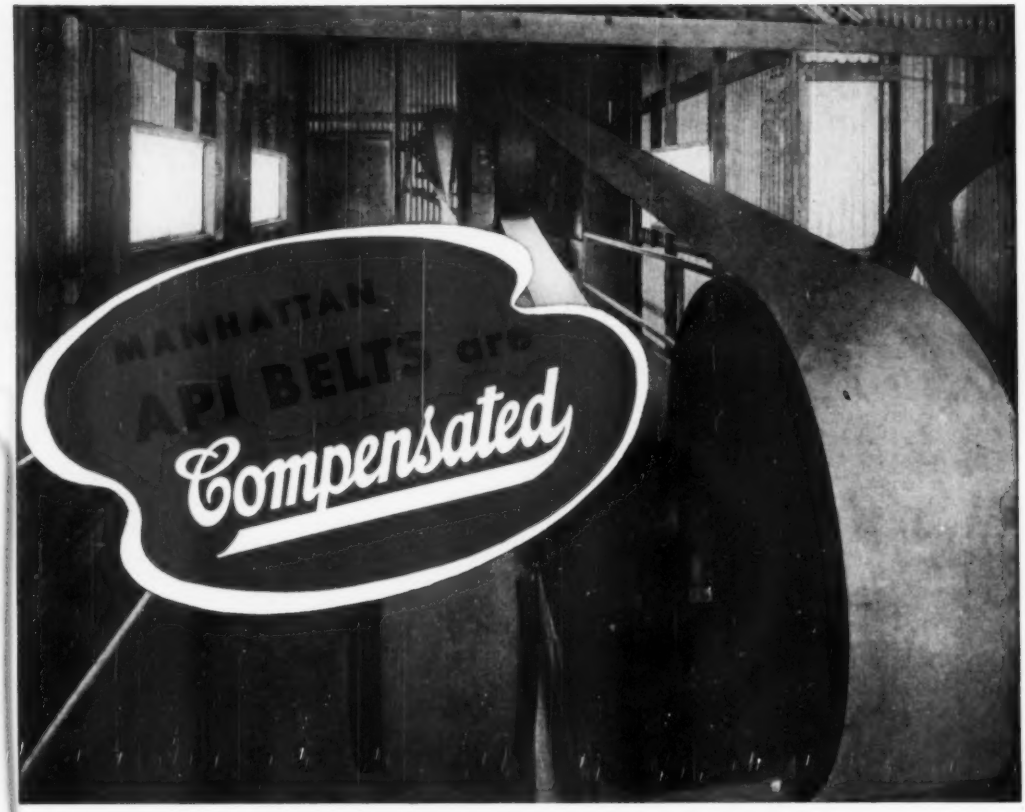
GRAVER CONSTRUCTION CO.

424 Madison Avenue, New York 17, New York

CHICAGO ENGINEERING DEPT.: 880 BERGEN AVENUE, JERSEY CITY, NEW JERSEY HOUSTON

GRAVER

A DIVISION OF GRAVER TANK & MFG. CO. INC. EAST CHICAGO, IND.



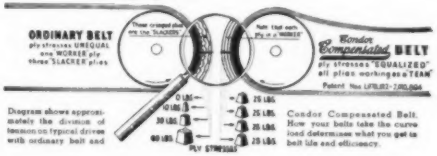
Ply Stresses Are Equalized

Manhattan's API COMPENSATED Belt construction is a patented development. It is unexcelled for long or short center drives . . . delivering top performance on countershaft hookups on pumping wells like the installation shown here.

Conventional belts, when rounding the pulleys, suffer unequal stresses on the plies. This causes top ply rupture or fastener trouble. To eliminate this, Manhattan employs an exclusive Compensation Principle in manufacturing API Belts. All plies, top to bottom, are made to pull with equal tension around the pulley circumference. (See diagram). There are 7 distinct advantages in a Manhattan API Compensated Belt, which are detailed in Bulletin 6873.

This bulletin ("Manhattan Belting for the Oil Fields") also describes WHIPCORD MANHATTAN ENDLESS BELTS, and CONDOR V-BELTS. Have you asked for your copy?

All Manhattan Rubber Products for the Oil Industry —Rotary Hose, Suction Hose, Oil Loading Hose, Water Hose, Belts, etc., etc.—are top investments in cost reducing equipment.


ORDINARY BELT
Condor Compensated BELT
Diagram shows approximately the division of tension on typical drives with ordinary belt and
Condor Compensated Belt. How your belts take the curve load determines what you get in belt life and efficiency.

Distributed by the National Supply Company

RAYBESTOS-MANHATTAN INC.

Keep Ahead with Manhattan

MANHATTAN RUBBER DIVISION **PASSAIC, NEW JERSEY**

Weld Aluminum with a "HELIARC" Torch and Cut Cleaning Costs

Trade-Mark

This manufacturer of aluminum truck bodies cut his cleaning costs to the bone by changing to the HELIARC welding process. With HELIARC welding he gets clean, sound welds with no spatter and without using flux. The net result of eliminating the cleaning of flux and spatter metal is a large saving in time, money, and materials.

You can get these savings too. Use the HELIARC process to weld aluminum, magnesium, Monel, and Everdur. No flux is used for any of these metals. HELIARC welds are so smooth and clean that many articles need no finishing. If the article is to be finished so that the welds do not show, it takes only a light grinding to remove the smooth, even ripple and produce a flush surface.

Get more information on the inert gas shielded arc welding process. LINDE's free booklets, on HELIARC welding show equipment, techniques and applications. Just mail in the coupon and we will send you this free helpful information.

"Heliarc" and "Linde" are registered trade-marks of The Linde Air Products Company.

THE LINDE AIR PRODUCTS COMPANY

Unit of Union Carbide and Carbon Corporation UCC

30 East 42nd Street, New York 17, N. Y.

In Canada: DOMINION OXYGEN COMPANY, LIMITED, Toronto

You can see the HELIARC process in operation at our booth in the National Metals Exposition—October 17-21, Cleveland, Ohio, or call any LINDE office for additional information on this process

THE LINDE AIR PRODUCTS COMPANY
30 East 42nd Street, Room 1402
New York 17, N. Y.

Gentlemen: Please send me more information about HELIARC Welding.

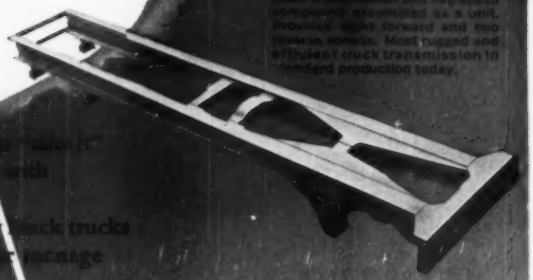
Name.....Position.....

Company.....

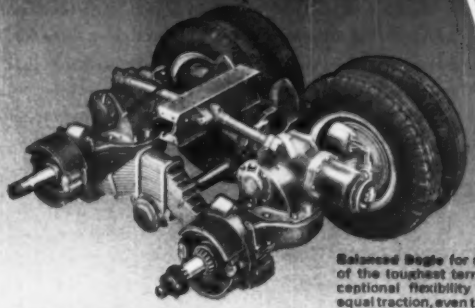
City.....State.....

Inside Reasons Why . . .

MACK TRUCKS
Take Out Bigger Payloads
Bring In Bigger Profits

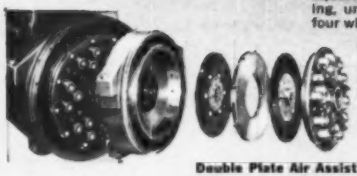


Massive Frame electrically fused into single unit. Alloy-steel I-beam side members are reinforced and braced by huge cross members. Capable of carrying great loads and standing up under tremendous shock.



Balanced Bogie for mastery of the toughest terrain. Exceptional flexibility insures equal traction, even tire loading, uniform braking on all four wheels.

Exclusive Power Divider. Delivers torque proportionately to wheels having the most traction. Eliminates dissipation of power in useless slippage and wasteful wheel spinning.



Double Plate Air Assist Clutch. Effortless in operation, reduces driver fatigue, requires minimum maintenance throughout its long life.

IT'S PART OF THE LANGUAGE:

"Built Like a Mack Truck"

Mack Trucks, Inc., Empire State Bldg., New York, N.Y. Factories at Allentown, Pa.; Plainfield, N. J.; New Brunswick, N. J.; Long Island City, N. Y. Factory branches and dealers in all principal cities for service and parts. In Canada: Mack Trucks of Canada, Ltd.

NEW... 25 TON CRANE ON RUBBER

NOW more crane *value* for your crane *dollar!*

WRITE FOR CATALOG T-70

Please specify type of carrier in which you're interested.

Here are two new rubber mounted Model 190 BAY CITY cranes, both having 25 ton capacities — the CraneMobile on the left — the CraneWagon on the right. Both are designed and built to meet requirements of heavier lifts and longer booms. The 190-T61 CraneMobile is a two-engine job with speeds up to 35 M.P.H., 9 feet wide over tires with outriggers that extend to 17 feet. The 190-CW CraneWagon is a self-propelled one-man operated crane with 4 travel speeds, 11 feet wide over tires and outriggers. Both are amply powered and equipped with independent boom hoist, power load lowering device, hi-collapsible gantry, pin-connected boom and many other features that will give you more crane value for your dollar. BAY CITY SHOVELS, INC., BAY CITY, MICHIGAN.

BAY CITY

SHOVELS • CRANES • HOES • DRAGLINES • CLAMSHELLS

See your nearest Bay City dealer for excavating and material handling equipment in sizes from ⅜ to 1¼ yard with crane rating up to 25 tons. Both crawler and pneumatic tire mountings.

for

SERVICE

you can always depend on...

call your

NORVELL-WILDER MAN

Quick service and complete stock SAVE YOU TIME and MONEY

NORVELL-WILDER

SUPPLY COMPANY

General Offices at Beaumont

How to INCREASE LIFE OF PUMPS

in salt-water transfer service

NO DETERIORATION FROM CORROSION or other sources was evident in "Worthite" casing, impeller and rings of this 2-stage Worthington centrifugal pump after 7 years of regular service.

STILL good AFTER 7 YEARS of steady work, this pump shows how increased service life, and corresponding economies, are readily obtained by using impellers, rings and casings cast in "Worthite", a corrosion-resistant alloy containing nickel.

A leading oil company, user of this pump, had opportunity to compare its long, steady savings, in contrast to the expenses of a pump in which bronze impellers and rings failed after less than a year, and where the total life of a plain iron casing was but 18 months.

In fact, cast iron and bronze are seldom able to withstand the high velocities and pressures necessary in most salt-water transfer and reinjection operations. Many other materials were tried by this oil producer, but eventually "Worthite" was adopted.

Developed by Worthington Pump and Machinery Corp., Harrison, N. J., and Lebanon Steel Foundry, Lebanon, Pa., "Worthite" contains, on an average, 24% nickel, 20% chromium and 3% molybdenum, along with silicon and copper.

"Worthite" is but one of scores of nickel-containing alloys that illustrate how the useful life of equipment can be greatly lengthened by proper selection of metal used for vital parts. Counsel and data to help you select the right alloys containing nickel for your requirements may be had upon request. Write us today.

Don't Forget...

INCO BOOTH NO. 302

Jot down—"INCO Booth, No. 302" —in your memo book of companies to visit at the **NATIONAL METAL EXPOSITION,** at the Public Auditorium in Cleveland, Ohio, October 17th to 21st. Convenient facilities for discussing your problems with our metallurgists and foundry specialists will be available.

THE INTERNATIONAL NICKEL COMPANY, INC. 67 WALL STREET NEW YORK 5, N. Y.

LITTLE BUSINESS GOES TO TOWN

Because It Has Exactly What The Town Needs And Wants!

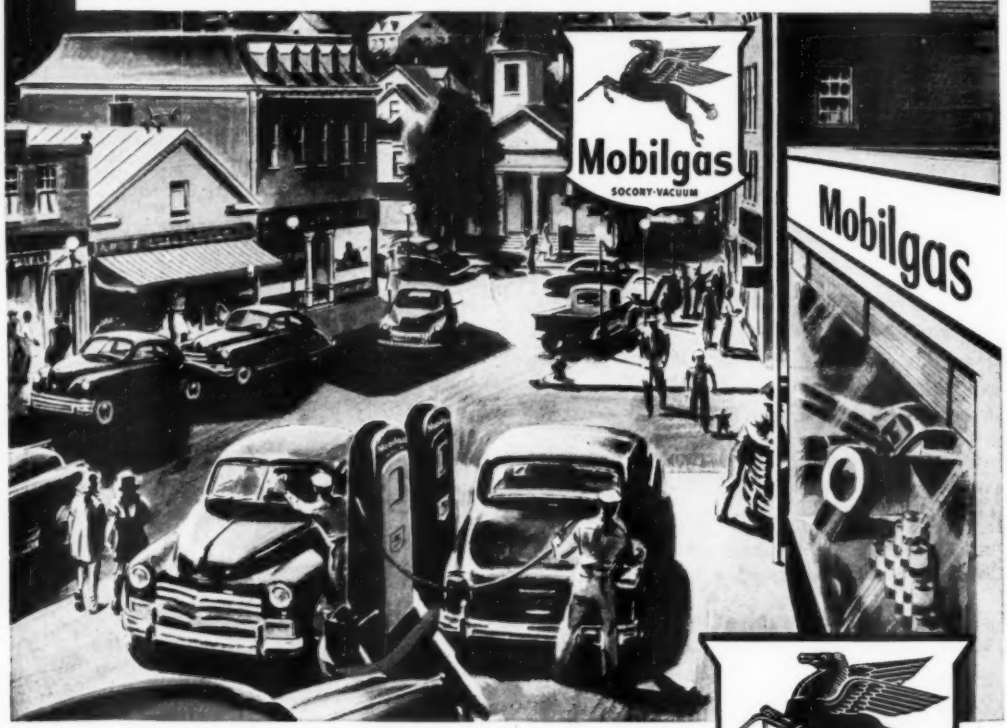
REMEMBER when the town's one service station had one pump . . . could serve only one thing —gasoline?

Look at it today—a successful, independent business fully equipped to supply a complete line of products and services for the town's cars.

How is your Mobilgas dealer able to do it? On whom does he rely for help?

Take a look at the trademark over his station. That famous Flying Red Horse stands for *everything he needs to keep competitive* . . . scientific research for vital product development . . . the latest in refining advances . . . new pipelines, tankers and storage facilities for top economy of oil transport and handling.

"Little business"? . . . Yes . . . but count on your Mobilgas dealer for *fine service and quality*. He's backed and supplied by the competitive efficiency and integrated organization of a leading American oil company—Socony-Vacuum.

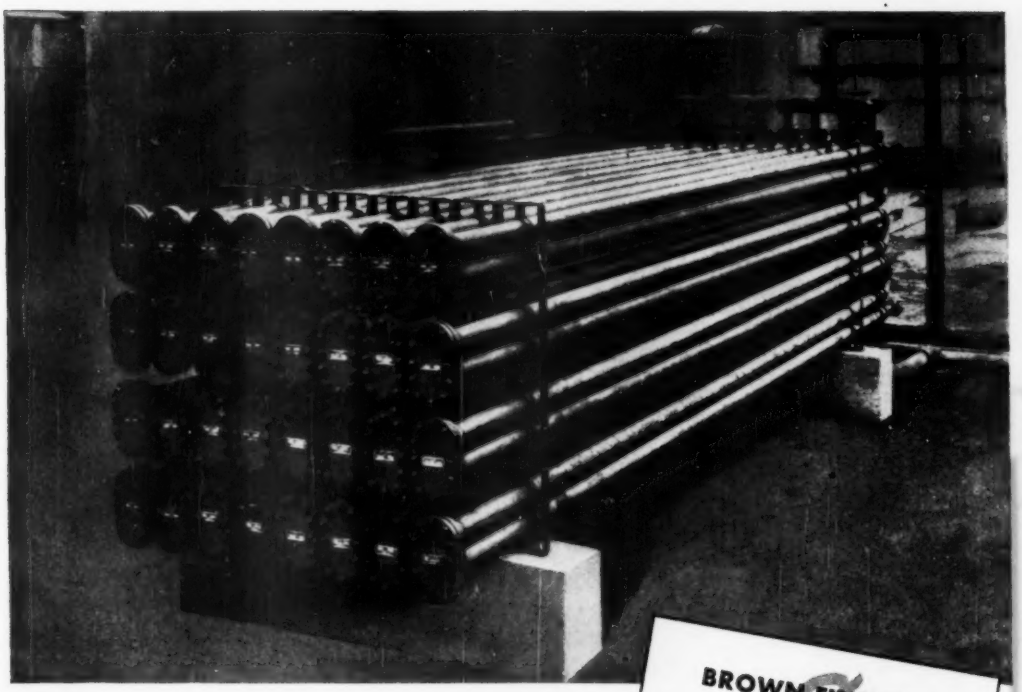


1400 INDEPENDENT JOBBERS— 45,000 INDEPENDENT DEALERS IN THE U.S.A.

. Rely on the Famous Flying Red Horse for What You Want!

SOCONY-VACUUM

SOCONY-VACUUM OIL COMPANY, INC., and Affiliates: MAGNOLIA PETROLEUM COMPANY, GENERAL PETROLEUM CORPORATION



extreme flexibility

Brown Fintube Sectional Heat Exchangers

are easily adaptable to changes in duty

● You'll get almost unlimited flexibility to meet changes in duties, plant re-arrangements, etc., with Brown Fintube Sectional Heat Exchangers. The banks can be changed over *easily* and *quickly,* to operate *efficiently* on almost any *new* and *different* duty. You simply add a few sections, remove a few sections, or change the series-parallel manifolding.

For the utmost in efficiency and economy use Brown's proven, welded fintube heat exchangers throughout your plant. Estimates and quotations furnished promptly. *Write for Bulletin No. 481.*

BROWN FINTUBE'S *advantages*

EXTREME FLEXIBILITY
Easily Adapted to Changes in Duty

NO OBSOLESCENCE
Avoiding Waste and Expense

FLANGED HEAD END ASSEMBLY
Eliminating Ground Joint Seals

EASY MAINTENANCE
Using Only Common Tools

CONTINUOUS OPERATION
No Shut-Downs For Cleaning

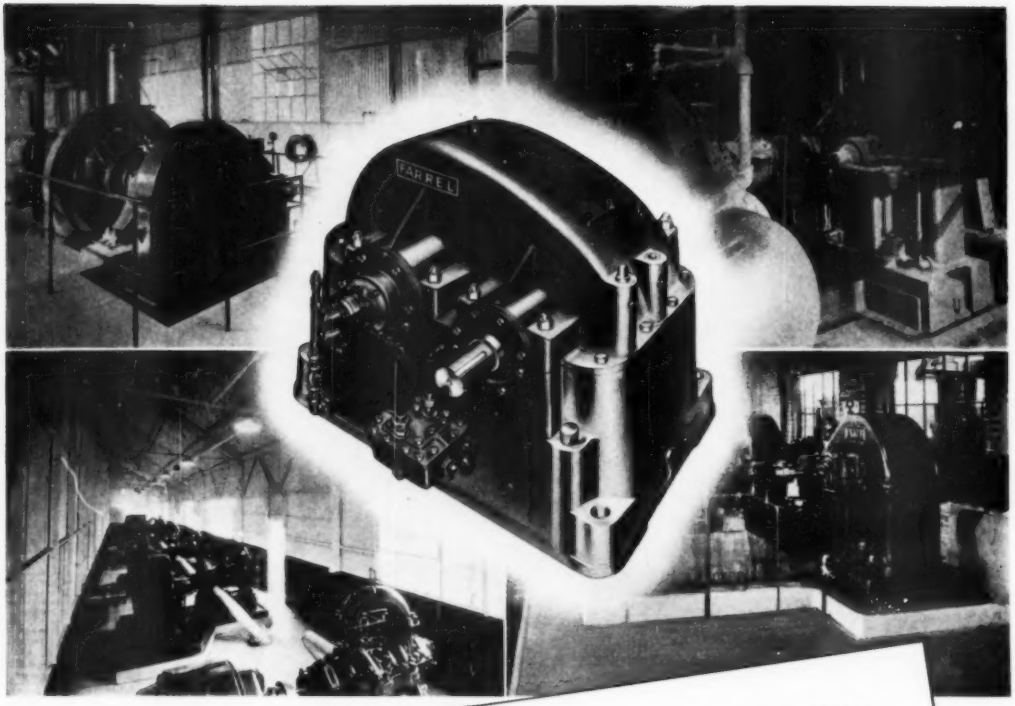
REDUCED STORES REQUIREMENT
Minimizing Investment and Handling

QUICK DELIVERY
Only a Few Hours in Emergency

INCREASED CORROSION ALLOWANCE
Longer Tube Life

THE BROWN FINTUBE CO.
ELYRIA, OHIO

SECTIONAL HAIRPIN HEAT EXCHANGERS



SPEED INCREASER—WITH A 17-YEAR BACKGROUND

Since 1932, when Farrel first developed a standard series of speed increasers for pipeline pumping service, hundreds and hundreds of these units have been installed throughout the oil industry.

The success of the installations—*every one is still in operation*—provides a virtual guarantee of trouble-free performance.

This modern line of speed increasers consists of 49 standard sizes with speed ratios ranging from 1:1 to 12:1. For higher ratios, units using two sets of gears are supplied with ratio range from 12:1 to 40:1.

For full information about these *time-proved* speed increasers, write for your copy of Bulletin No. 448. No cost, no obligation.

FARREL-BIRMINGHAM COMPANY, INC.
344 VULCAN STREET, BUFFALO 7, N. Y.
Plants: Ansonia and Derby, Conn., Buffalo, N. Y.
Sales Offices: Ansonia, Buffalo, New York, Boston, Pittsburgh, Akron, Cleveland, Detroit, Chicago, Los Angeles
OIL FIELD REPRESENTATIVES
Hercules-Lupfer Engine Sales Co., 124 N. Boston St., Tulsa 1, Okla.
V. W. Osborne, 822-A M & M Building, Houston 2, Texas

FB-551

Farrel-Birmingham

AXELSON FIRST CHOICE

There is

ONE

best plunger..

for each SPECIFIC well condition

AXELSON STEEL PLUNGERS are designed to give maximum service under all well conditions. "Regular" Plungers, threaded at both ends for conventional A.P.I. valve fittings, are highly polished throughout the entire length and are recommended for ordinary service. Hardened Steel Plungers, designed to A.P.I. specifications, are recommended for more severe pumping conditions. Axelson Stainless Steel Plungers are also manufactured in every A.P.I. size and type. All AXELSON Plungers are available with heavy chrome plating, accurately ground and highly polished, offering superior performance due to the hard, wear-resistant surface.

EXCLUSIVE AXELSON BARNWELL FEATURE incorporates an inwardly-beveled upper lip which produces a wiping action on the upward stroke and deflects sand or other deposits into the fluid column. Double Barnwell plungers are also available, both ends designed with the exclusive Barnwell scraper feature.

THE AXELSON PATENTED PERRY VALVE reduces gas-locking to an absolute minimum. The entire valve is contained within the lower end of the plunger, allowing free upward passage of both fluid and gas. This elimination of gas trap space is particularly effective in deep wells where low compression ratio would cause a large portion of the working stroke to be lost in compressing and expanding the entrapped gas.

AXELSON PIN-END PLUNGERS are designed to give improved service life of the chrome plating. Both ends of the plungers are externally threaded, thus eliminating the hazard of damaging the chrome plating as there are no internal threads to expand when the plunger fittings are tightened.

Pin-end Plungers, as well as all Axelson Plungers, are available with the Axelson grooved feature which produces added efficiency through the sealing effect produced by turbulence in the grooves. This permits the use of a looser-fit plunger and reduces friction without loss of production.

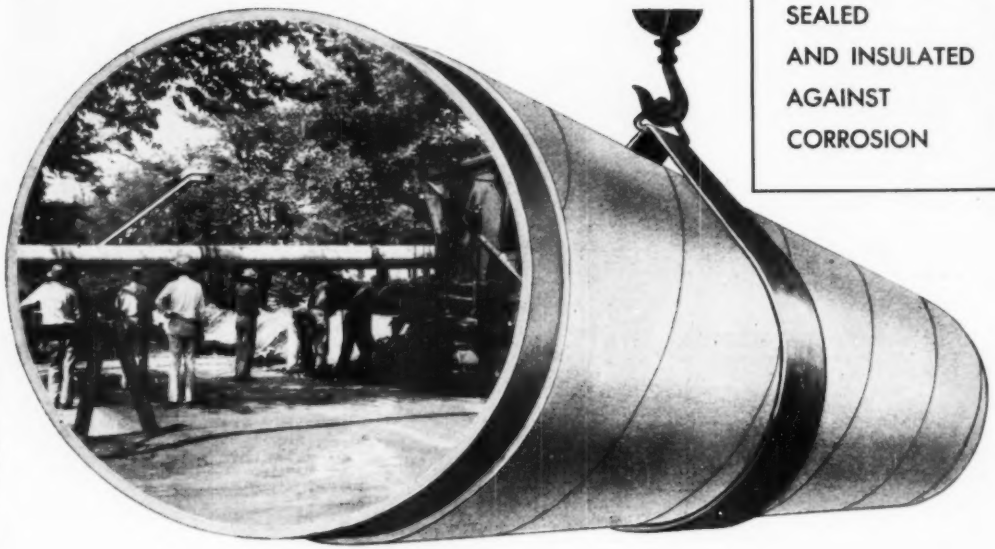
DEEP WELL PUMP

AXELSON *Plungers*

AXELSON FIRST CHOICE *in sucker rods, deep well plunger pumps, pump components, and hydraulic long stroke pumping units.*

THERE IS NO ECONOMICAL SUBSTITUTE FOR QUALITY

AXELSON MANUFACTURING CO. • **PLANTS** — Los Angeles 11, St. Louis 16 • **OFFICES** — New York City 7, Tulsa 1; Buenos Aires, Argentina; Caracas, Venezuela • **DISTRIBUTORS** — Jones & Laughlin Supply Co.; Great Northern Tool & Supply Co.; C. C. McDermond, Maracaibo, Venezuela; Industrial Agencies, Ltd., San Fernando, Trinidad, B W I.; Industrias Waldrip & Campbell, Caracas, Venezuela.



SEALED
AND INSULATED
AGAINST
CORROSION

with *Reilly* Pipe Enamel

Reilly Primer and Pipe Enamel provide a coating of high dielectric strength which is so tightly bonded to the steel as to seal and insulate it completely against its environment and thus prevent all corrosive agencies from coming in contact with the metal.

This tough, durable Reilly coating is so regulated in its properties that it can withstand temperatures as low as minus 20° F. without cracking or checking, and as high as 160° F. without flow or sag.

Reilly Pipe Enamel is manufactured in two standard grades, also to meet special requirements. It is readily applied—at the mill or in the field—by any of the standard methods.

Reilly Cold Application Coatings provide dependable, economical protection to storage tanks and other exposed metal surfaces.

REILLY TAR & CHEMICAL CORPORATION

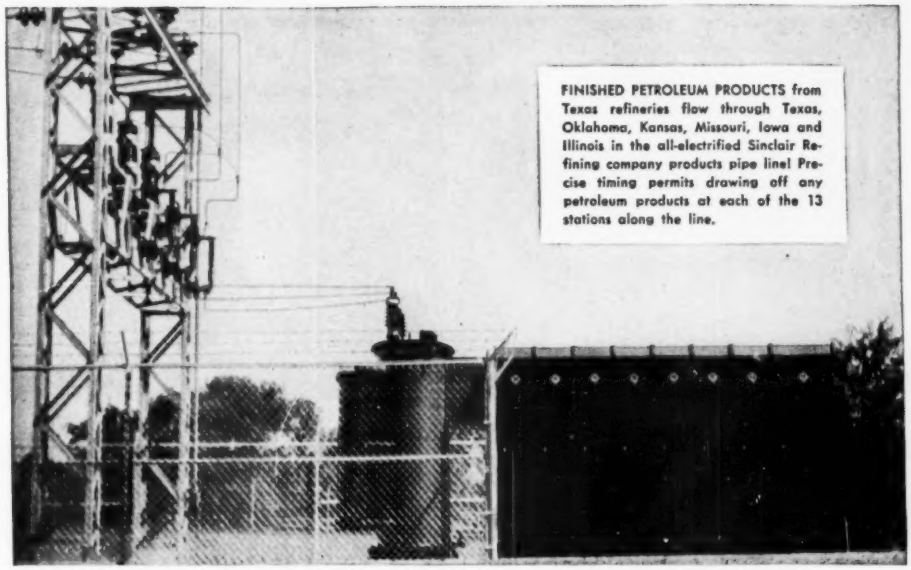
MERCHANTS BANK BLDG., INDIANAPOLIS 4, IND.

500 FIFTH AVE., NEW YORK 18 • 2513 S. DAMEN AVE., CHICAGO 8

Reilly Protective Coatings

A copy of this booklet, describing Reilly Protective Coatings for all types of surfaces, will be sent on request.

Switchgear Units Protect 1500 Mile Sinclair Pipe Line!



FINISHED PETROLEUM PRODUCTS from Texas refineries flow through Texas, Oklahoma, Kansas, Missouri, Iowa and Illinois in the all-electrified Sinclair Refining company products pipe line! Precise timing permits drawing off any petroleum products at each of the 13 stations along the line.

45 Allis-Chalmers outdoor, high-voltage switchgear units and 28 Type "H" auxiliary units protect vital power supply!

THESE ALLIS-CHALMERS SWITCHGEAR UNITS are equipped with 50 mva interrupting capacity, air magnetic breakers, thermal overload and undervoltage relays. These switchgear units combined with Allis-Chalmers OISC transformers form *unit substations* that provide remote starting and stopping of station equipment.

NOTE THESE SWITCHGEAR FEATURES!

☛ Steel-enclosed cubicles are completely weather-proof.

☛ Each unit is operationally safe; complete with interlocks and grounded, all-steel compartments. ☛ Standard design of the pre-fabricated units provides uniform maintenance in all similar installations.

In addition, pump drives for these Sinclair stations are new Allis-Chalmers tube-type, explosion-proof 400 hp motors!

For complete information on the job Allis-Chalmers switchgear can do for you, call your nearby A-C Sales Office or write direct.

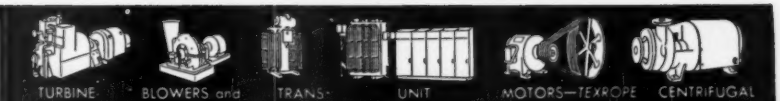
A-2795

ALLIS-CHALMERS, 1059A SO. 70 ST.
MILWAUKEE, WIS.

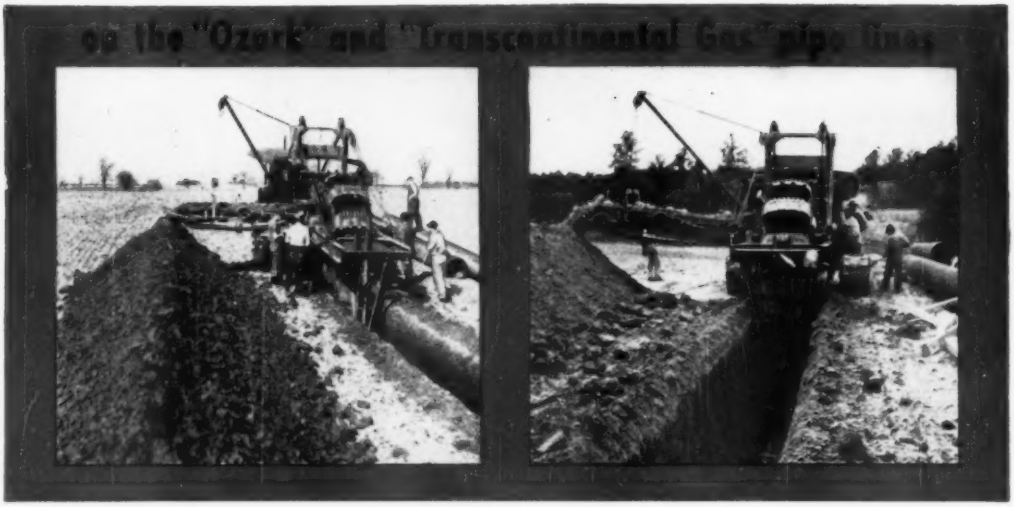
ALLIS-CHALMERS

Texrope is an Allis-Chalmers trademark.

Power, Electrical, Processing Equipment for Petroleum Industry



for low cost and high speed ditching



Buckeye Model 51 Pipeline Ditchers are used

"Continental Gas" and "Ozark" are typical of the many large pipe line jobs which have used, are using, and will use the Buckeye Model 51 Ditcher. There is a good reason for this almost universal preference . . . contractors have found that they can cut their ditching costs, save time and avoid delays by using Buckeye Ditchers.

Among the many important advantages of the Model 51 are: 32 digging speeds up to 35 ft/min; 110 hp (@ 850 rpm) heavy-duty Diesel engine provides abundant power with minimum fuel consumption; cuts a smooth ditch up to 50" wide and 8'-6" deep; design is simple and servicing is easy. The "51" can maintain a level ditch while digging up or down a grade, and the new replaceable rooter bits cut a clean face and last longer. Ground bearing pressure is low and safety device holds ditcher on grades. If you have a large pipe line job, you can't afford to be without the Buckeye Model 51 Pipeline Ditcher. Write for Bulletin 51.

GAR WOOD INDUSTRIES, INC.
FINDLAY DIVISION—FINDLAY, OHIO

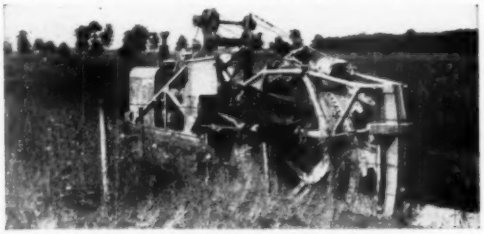
GAR WOOD GW INDUSTRIES **Buckeye**
Ditchers · Shovels · Spreaders · Finegraders

Other Products: Gar Wood Scrapers, Dozers, Hoists, Dump Bodies, Winches, Cranes and Tanks; St. Paul Hoists, Dump Bodies and Truck Patrols.

Smaller Buckeye Ditchers That Also Dig Faster and Cut Costs per Foot of Ditch

Buckeye Model 312 Pipeline and Heavy Duty Utility Ditcher

Widely used for cross-country and gathering lines to 12", refinery installations, etc. Cuts ditch from 16" to 30" wide and to 6' deep. Ask for Bulletin 312.



Buckeye Model 306 Utility Ditcher

Popular for gathering lines, gas distribution systems, water lines, electric conduit, etc. Cuts ditch from 12" to 24" wide and to 5'-6" deep. Write for Bulletin 306.

5381

A NEW IDEA

in PORTABLE PUMPING POWER

THIS mobile mainline pumping unit, owned and operated by Magnolia Petroleum Company, Dallas, sets a new standard of efficiency in portable pipe line pumps.

Powered by a General Motors Series 71 Diesel Quad 6, it has a capacity of 45,000 barrels of crude oil per day at 350 psi line pressure. Engineered to fit within road width, the entire unit weighs less than 30,000 pounds, including trailer.

Oil men everywhere find it pays to depend upon General Motors Diesels for their power requirements. These 2-cycle engines not only cut operating costs, but also provide fast, flexible power in space-saving, weight-saving units.

Let us show you how these modern Diesels can bring greater efficiency and economy to your particular job. Available in "Singles", "Twins" and "Quads"—43 to 520 continuous B. H. P. Write for illustrated folder, "A New Idea In Portable Pumping Power".

DETROIT DIESEL ENGINE DIVISION

SINGLE ENGINES... *Up to 200 H.P.* **DETROIT 28, MICHIGAN** MULTIPLE UNITS... *Up to 800 H.P.*

GENERAL MOTORS

DIESEL BRAWN WITHOUT THE BULK

GM GENERAL MOTORS DIESEL POWER

GENERAL MOTORS CORP., DIESEL ENGINE SALES, PETROLEUM INDUSTRY, 1504 Philtower Bldg., TULSA 3, OKLAHOMA

Anderson-O Brien Co. LOS ANGELES 21, CALIFORNIA
George Engine Co. NEW ORLEANS 18, LA.
Western Machinery & Engine Co. ST. LOUIS 10, MISSOURI
Diesel Power Co. OKLAHOMA CITY, OKLAHOMA
Empire Machinery Co., Ltd. ODESSA, TEXAS
West Coast Engine & Equip. Co. BERKELEY, CALIFORNIA
United Tool & Valve Repair Co. SHREVEPORT, LOUISIANA
Seitz Machinery Company Inc. BILLINGS, MONTANA
Stewart & Stevenson Services Inc. HOUSTON 11, TEXAS
Gehring Equipment Co. CASPER, WYOMING
Haynes Machinery Co. PLAINVIEW, TEXAS
Scranton Machine & Supply Co. GREAT BEND, KANSAS (Dealer)
Mountain Tractor Co. MISSOULA, MONTANA
Diesel Equipment Co. WICHITA, KANSAS

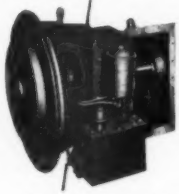
Squeeze Play
THAT SCORES . . .

With two powerful engines, each driving through a Twin Disc Hydraulic Torque Converter, the Spartan Tool and Service Company's high-pressure cementing trucks adequately handle any type of cementing or squeeze operation encountered . . . are capable of 13,000 psi working pressure.

Through these two Twin Disc Torque Converters, the exact pressure required for any squeeze or breakdown-of-formation job is easily obtained . . . smoothly and without violent impact loads on equipment or casing. In addition to greater pump flexibility, Twin Disc Converters provide a means of holding any required stall pump pressure for long periods of time . . . allow a wider variety of pressure-volume relationships from the pumps.

Wherever you find oil production equipment, you'll find Twin Disc Hydraulic Torque Converters . . . on drilling rigs, slush pumps, independent rotary table drive units, special purpose pumps, servicing winches and various other specialized applications. Their greater over-all torque multiplication and shock absorbing qualities are adaptable to all. Write for Bulletin 135-C.

TWIN DISC CLUTCH COMPANY, Racine, Wisconsin
(Hydraulic Division, Rockford, Illinois).



Twin Disc Hydraulic Torque Converter (Lysholm-Smith type).

On this Spartan Cementing Truck, a Hall-Scott 400 engine supplies power to the forward pump through an independently mounted Twin Disc 11500 Series Converter. The rear pump is powered by a Waukesha 145-GKU engine driving through a Twin Disc 10000 Series Converter.

Heavy Duty Clutch

Machine Tool Clutch

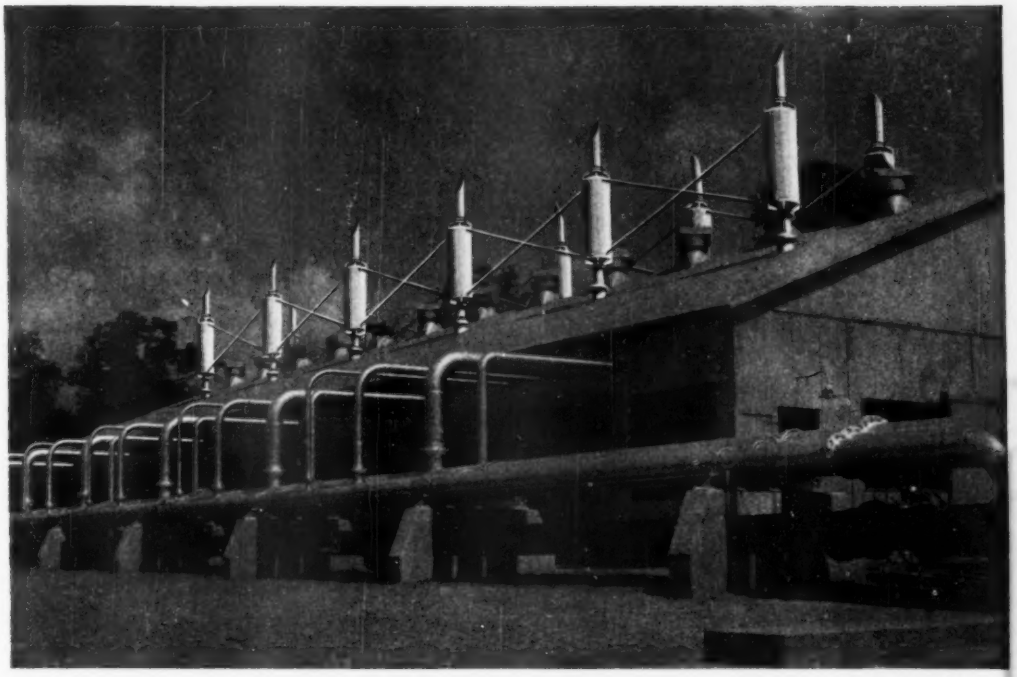
Power Take-off

Tractor Clutch

Marine Gear

TWIN DISC
CLUTCHES AND HYDRAULIC DRIVES
REG. U.S. PAT. OFF.

SPECIALISTS IN INDUSTRIAL CLUTCHES SINCE 1918



Burgess-Manning Snubbers on twelve 300-hp engines of the Warren Petroleum Corporation plant of Crossville, Illinois.

Snub the Slug-and Stop the Noise

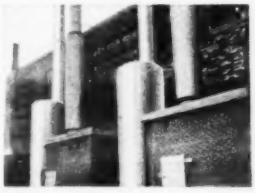
FROM ENGINE EXHAUSTS

Diesel and other internal combustion engines can be operated anywhere . . . without exhaust noise . . . when you equip them with Burgess-Manning Exhaust Snubbers. Widely used for such critical locations as office buildings, hospitals, community installations, ships, oil fields, and industrial applications where no exhaust noise disturbances can be tolerated or where danger of explosions or flying sparks must be eliminated.

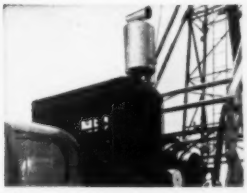
Burgess - Manning Snubbers prevent noise by dissipating the "slugs" of gas from engine exhausts . . . with no interference to high engine performance. Special "Fog-jet" Snubbers snub the "slugs" to prevent exhaust noise, scrub out glowing sparks, spray a mist of cooling water vapor on the exhaust gases entering the Snubber . . . to cool and extinguish flame from the engine.

Burgess-Manning Snubbers are designed for Diesel, gas, dual fuel, and gasoline engines used in stationary, marine, locomotive, and portable service. A wide variety of types and sizes of Snubbers are available.

If you are considering the installation of Diesel or other type internal combustion engines, or if you have existing mechanical problems in exhaust systems, or noise complaints, let Burgess-Manning submit Snubber recommendations. Long experience guarantees satisfaction. Write for literature.



South Norwalk Electric Plant is equipped with Burgess-Manning Standard Industrial Exhaust Snubbers.



Oil-well servicing truck fitted with a Burgess-Manning Spark Arrester-Snubber.

Tuna purse seiner, "Santa Helena," uses Burgess-Manning SDM Marine Spark Arrester-Snubbers.

BURGESS-MANNING COMPANY

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Here's the **NEW**

WHELAND B-85

DRAWWORKS WITH CONSOLE CONTROL

Torque-Tube Direct Driven Rotary Table

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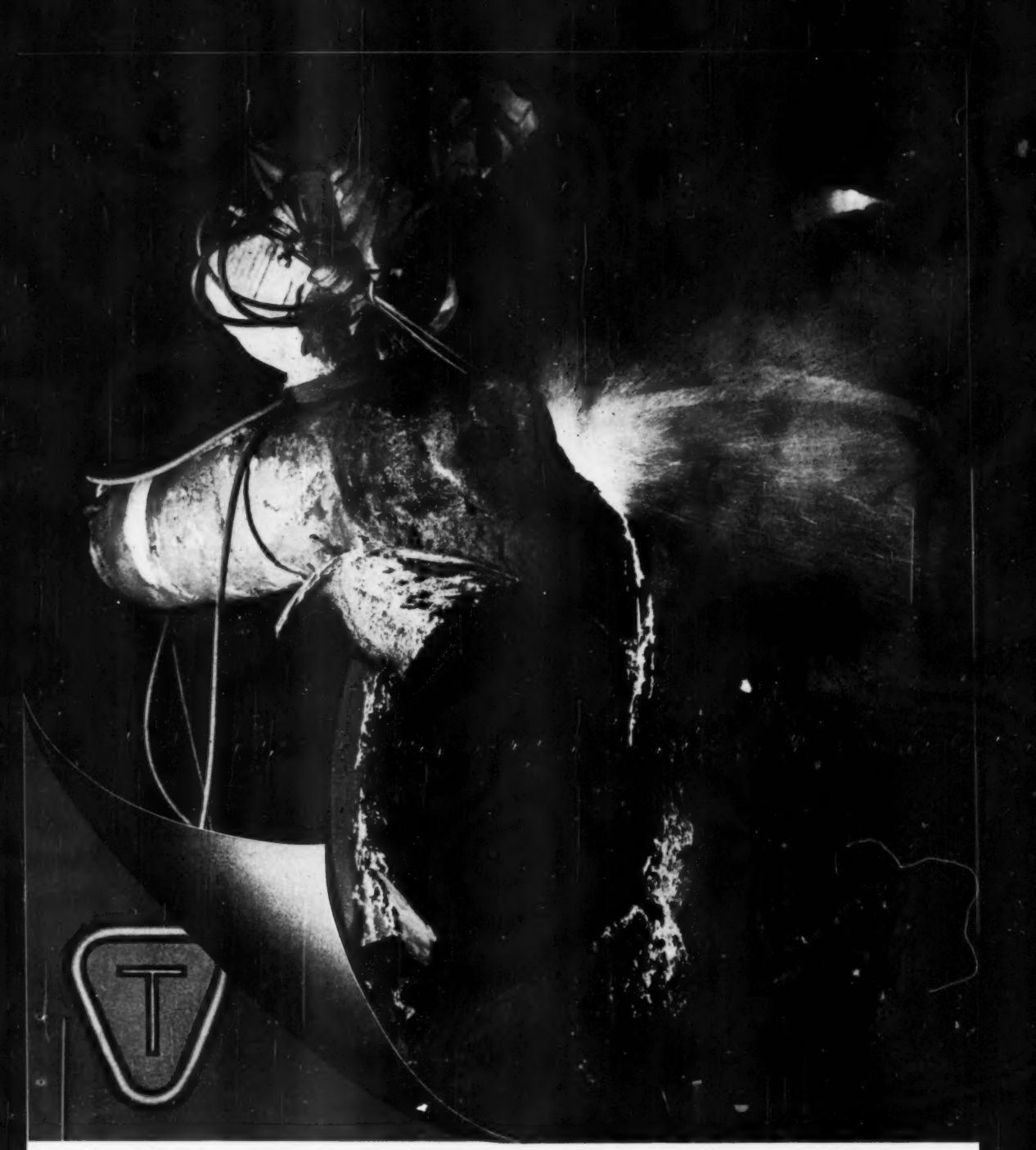


TESCO IS EQUIPPED TO CAST THE BIG ONES!

THIS 30" PIPE LINE CHECK VALVE casting measures five feet long, five feet high and weighs 7000 lbs. It is typical of the large castings which TESCO regularly produces for pipeline equipment manufacturers. Removing risers with acetylene torches, as shown here, is one of TESCO'S finishing operations. Grinding, sandblasting and rigid final inspections will assure the equipment manufacturer of a strong, sound casting which will require minimum machining. Let the TESCO Representative show you how steel castings can help you produce stronger, better appearing products at less cost. TESCO is the most experienced foundry on the Gulf Coast. TEXAS ELECTRIC STEEL CASTING COMPANY, HOUSTON, TEXAS.

Marmon-Herrington

ALL-WHEEL-DRIVE

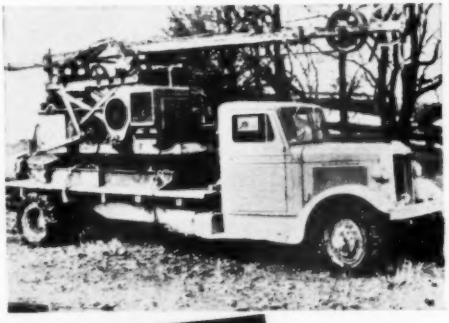
wherever the going is tough

Oil men the world over know there are no trucks on earth to compare with Marmon-Herrington *All-Wheel-Drives*—not when there are really tough trucking jobs to be done.

Live power and traction on all wheels is the answer. With front wheels pulling, rear wheels pushing, these great trucks have the sure-footed tractive power of crawler tractors—plus truly amazing speed and maneuverability. Here are trucks that carry on where those of conventional drive stop—trucks capable of transporting peak payloads through deep mud, sand and snow, up steep hills and mountain grades—speedily, easily, economically.

In all, there are 22 *All-Wheel-Drive* models in the Marmon-Herrington line—a model with the right size, power and capacity for every conceivable oilfield need. Wheelbases range from 110″ to 220″—gross vehicle weights from 5,300 pounds to 42,000 pounds.

For a demonstration of almost unbelievable performance-ability, see your Marmon-Herrington *All-Wheel-Drive* Truck dealer. There's one near you.



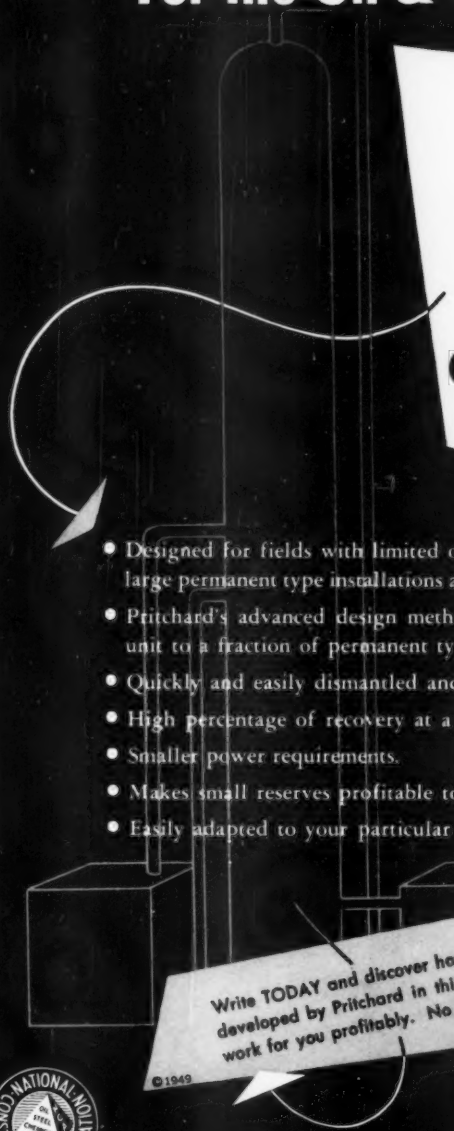
MARMON-HERRINGTON COMPANY, INCORPORATED

MARMON-HERRINGTON

Indianapolis 7, Indiana

PRITCHARD *Leads Again* to Design

For the Oil & Gas Industry



the NEW *Trans-Portable* LEASE UNIT GASOLINE EXTRACTOR *and* TREATER

- Designed for fields with limited or uncertain reserves, where large permanent type installations are economically unjustified.
- Pritchard's advanced design methods reduce the cost of this unit to a fraction of permanent type units.
- Quickly and easily dismantled and transported to other sites.
- High percentage of recovery at a fraction of former costs.
- Smaller power requirements.
- Makes small reserves profitable to process.
- Easily adapted to your particular extraction requirements.

Write TODAY and discover how the advanced design methods developed by Pritchard in this extraction plant can be put to work for you profitably. No obligation, write TODAY!

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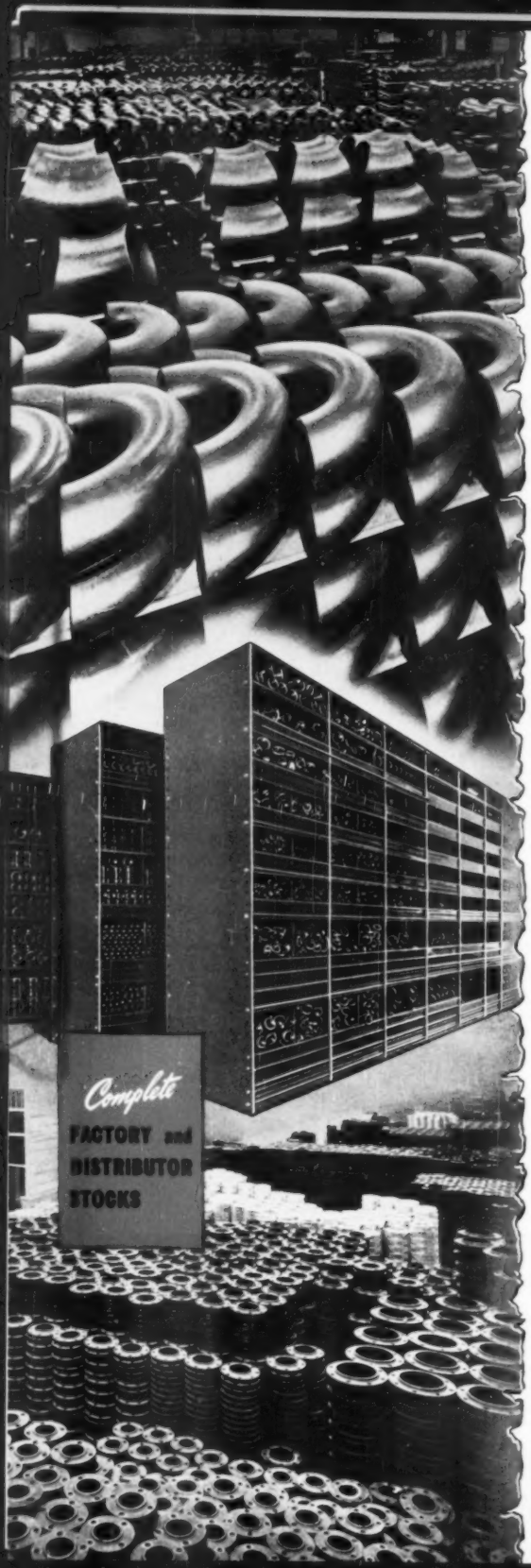


all three on one order from Ladish

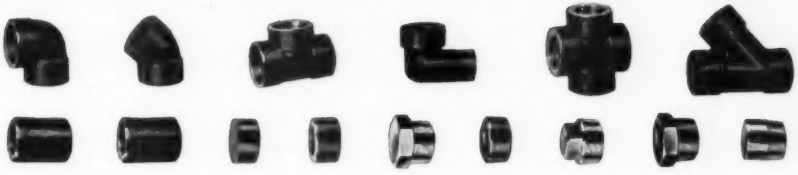
TO MARK PROGRESS

every piping system deserves the protection

SEAMLESS WELDING FITTINGS—½ INCH THRU 30 INCHES

FORGED STEEL FLANGES—½ INCH THRU 30 INCHES—LARGE O.D. THRU 96 INCHES

FORGED STEEL FITTINGS—SCREWED AND SOCKET WELDING—⅛ INCH THRU 4 INCHES



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ALLOY
STAINLESS STEELS
ALUMINUM
COPPER & OTHER
NON-FERROUS
METALS

Means savings in time and dollars...for LADISH offers you a complete line backed with adequate stocks

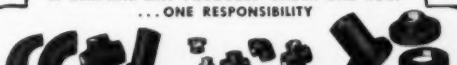
Whatever your fitting requirements . . . you can rely on the Ladish line for an unrestricted selection of Seamless Welding Fittings, Forged Steel Flanges and Forged Steel Fittings.

This Controlled Quality line is complete in types, size ranges and materials you need for virtually any application. Ladish also gives you such outstanding engineering developments to improve piping efficiency, as Seamless Reducing Elbows and Full Branch Taper Design Tees.

Adequate stocks in strategically located distributor warehouses . . . supplemented by extensive factory inventories of every type . . . give you double assurance of prompt service on every Ladish order. And, by standardizing on Ladish you know that every fitting is made to the unsurpassed standards of Controlled Quality for complete dependability.

of *Controlled Quality* fittings

A COMPLETE LINE PRODUCED UNDER ONE ROOF
. . . ONE RESPONSIBILITY



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PROTECTION SERVICE

Covers Every Pipe-coating Need

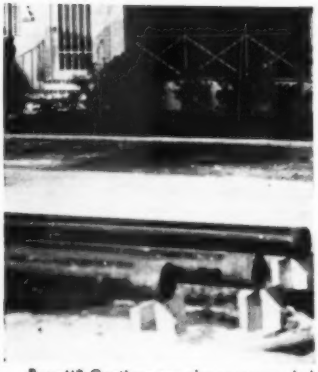
Materials and Application Procedure for:

1. **Water Industries**
2. **Natural Gas, Crude Oils and Products Transmission**
3. **Professional Application in Plants and Yards**
4. **Distribution Systems**
5. **Reconditioning Operations**
6. **Gathering Systems**
7. **Recycling Operations**

Materials and Application Procedure for

DISTRIBUTION SYSTEMS

Because of the high cost of distribution pipelines, their relative inaccessibility for repair, and the inherent possibility of leak hazards, it is imperative that only the finest coatings be used for their protection. Barrett* Enamels are ideal for such use. Their great flexibility and ductility enable them to withstand the flexing of the pipe. They also resist wide extremes of heat and cold without cracking. This latter quality is highly important when pre-coated pipe is bought and stored on skids until needed. The Barrett organization will be glad to confer with you on any of your pipe coating problems.



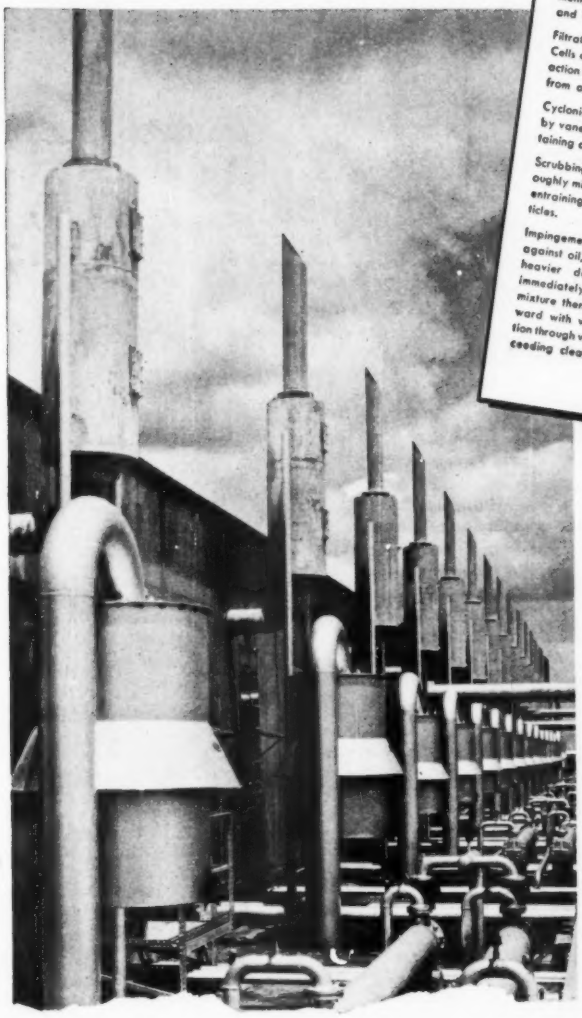
Barrett* Coatings are also recommended for protecting joints after sections of the pipe have been welded together.

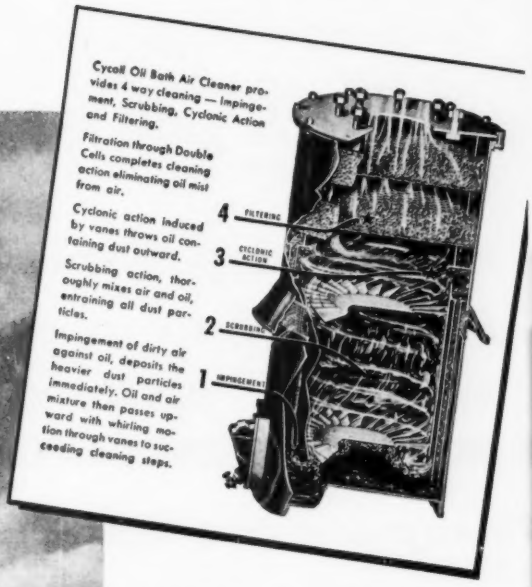
THE BARRETT DIVISION
ALLIED CHEMICAL & DYE CORPORATION
40 Rector Street, New York 6, N. Y.

*Reg. U. S. Pat. Off.

CYCOILS gobble up trouble

before it starts




Cycoil Oil Bath Air Cleaner provides 4 way cleaning — Impingement, Scrubbing, Cyclonic Action and Filtering.
Filtration through Double Cells completes cleaning action eliminating oil mist from air.
Cyclonic action induced by vanes throws oil containing dust outward.
Scrubbing action, thoroughly mixes air and oil, entraining all dust particles.
Impingement of dirty air against oil, deposits the heavier dust particles immediately. Oil and air mixture then passes upward with whirling motion through vanes to succeeding cleaning steps.
4 FILTERING
3 CYCLONIC ACTION
2 SCRUBBING
1 IMPINGEMENT

ENGINE troubles resulting from dust-laden intake air are both real and costly. But they will never be a threat at this Oklahoma refinery. Each of the 16 Cooper-Bessemer compressors, representing a total of 10,400 HP, is on a strict diet of dust-free air supplied by a Cycoil* Oil Bath Cleaner.

Cycoil doesn't compromise with dust. Over 90% of the total fine dust content of the air is trapped by the oil bath action of the Cycoil even before reaching the filter pads. Positive oil circulation for continuing self-cleaning action, plus the additional filtration to be had in the filter pads, assures approximately 100% clean air.

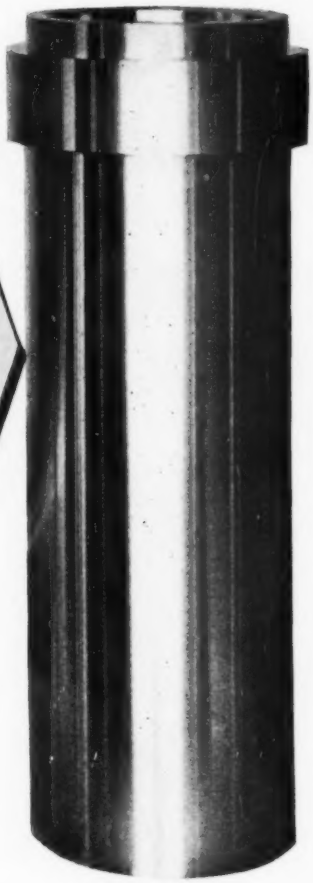
Thousands of engines and compressors are today guarded by Cycoils. Their freedom from dust damage over the years gives proof of this oil bath air cleaner's effectiveness. Complete information on Cycoil's positive protection is contained in Bulletin 130-D. Write for it now.

AMERICAN AIR FILTER COMPANY, INC.
444 Central Avenue, Louisville 8, Ky.
In Canada: Darling Bros., Ltd. Montreal, P. Q.

**Trade mark registered U. S. Patent Office*

AAF. Cycoil OIL BATH AIR CLEANER
AND INTAKE SILENCER

The extra life in "TOOL STEEL PROCESS" slush pump liners is equivalent to "stand-by" protection!



Compare these field records:

Fields	"Tool Steel" Liners	Competitive Hardened Liners
Illinois	67,228 ft.	14,231 ft.
Lindsay, Okla.	90 days (av.)	27 days (av.)
Chocolate Bayou, Texas	65,000 ft. (av.)	20,000 ft. (max.)
Texas Gulf	27,000 ft. (av.)	10,000 ft. (av.)
Leeville Field, La.	864 hours	240 hours (max.)
Blue Lake, Texas	40,000 ft. (still in service)	18,000 ft. (max.)

"Tool Steel" precision-made slush pump liners are producing 2 to 4½ times the footage of ordinary liners! This superior service life can be equalled by no other liners!

Wearing surfaces are 650-740 Brinell and are file hard to a depth sufficient for the life of the liner.

Central stocks maintained by our Agents serve the entire Southwest. Immediate shipment on all popular sizes through your regular Supply Store source. Also made to your specifications.

"TOOL STEEL" OIL FIELD REPRESENTATIVES

LYNN ELLIOTT COMPANY, 322 M & M Building, Houston 2, Texas

H. H. KUMLER COMPANY, 1642 East 3rd Street, Tulsa 6, Oklahoma

BUD BRANDEBERRY
Russell, Kansas

OIL FIELD EXPORT OFFICE, E. L. Carter
30 Rockefeller Plaza, New York 20, New York

"TOOL STEEL" PROCESS

The Standard of Quality

for LINERS• SPROCKETS• WASH PIPES• SHEAVES *and other* HARDENED PRODUCTS

THE TOOL STEEL GEAR & PINION CO.
CINCINNATI 16, OHIO, U. S. A.

NEW Edward INSTRUMENT VALVES

For Orifice Meters, Regulators, Gage Lines, Instrument Panels, Christmas Trees, By-pass Lines, etc.

HERE'S A NEW DESIGN in instrument valves — forged steel for strength in high temperature or high pressure service; no bonnet joint, swing bolted gland for easy packing adjustment.

Compact enough to fit the limited spaces of panel boards, this new Edward instrument valve is especially designed for close regulation on meter and regulator lines, too.

Built in globe or angle design, screwed or socket welding ends, ¼ in., ⅜ in., and ½ in. sizes. Working pressure ratings 6000 lb WOG, 1500 lb at 850 F with carbon steel bodies, and 1500 lb at 1000 F with 13 per cent chromium EValloy stainless steel bodies. Write today for Bulletin 491.

ACTUAL VALVE SIZE ▶

NEW FIG. 952 SERIES

EDWARD VALVES, INC.
1492 West 145th St., East Chicago, Ind.
Please send me Bulletin 491—on Fig. 952 Series

Name

Company

Street Zone State

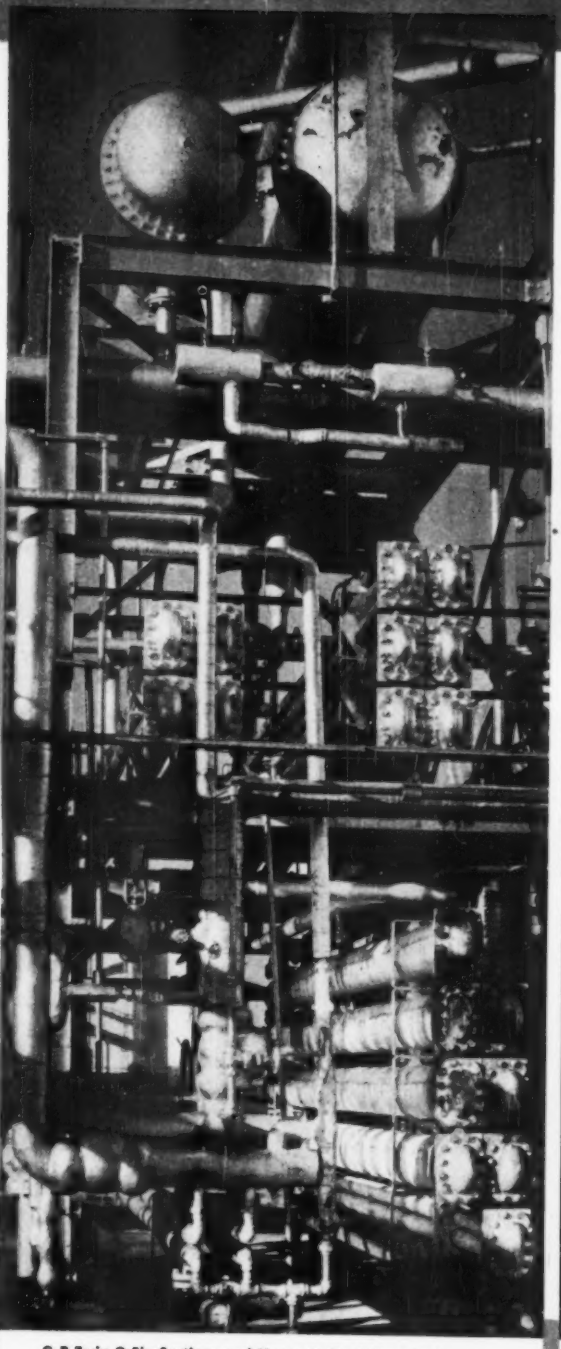
City

Another Product

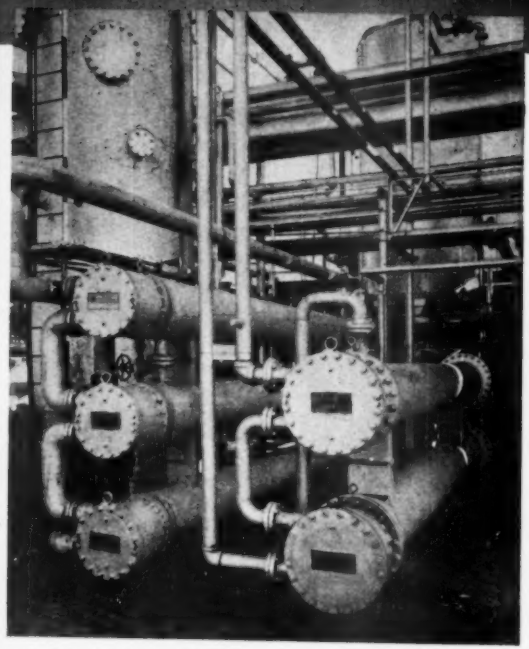
Edward Valves, Inc.

Subsidiary of ROCKWELL MANUFACTURING COMPANY

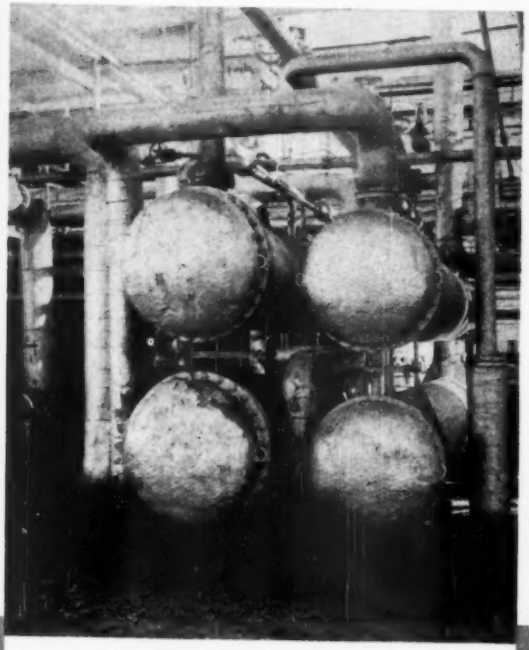
EAST CHICAGO, INDIANA



G-R Twin G-Fin Sections and Vapor-to-Feed Heat Exchangers



At left, G-R Heat Exchangers, and at right, G-R Gas Coolers



G-R Residue-to-Crude Heat Exchangers

GRISCOM-RUSSELL — PIONEERS IN HEAT TRANSFER APPARATUS

G-R EQUIPMENT

Helps This Cosden Refinery Operate with Sour Crude

The Big Spring, Texas, plant of Cosden Petroleum Corporation must contend with exceptional operating and maintenance problems because of the sour crude which this plant has always refined. However, the engineers and technologists of the plant have successfully solved these problems by the special treatment of the crude which they have developed and by their selection of equipment and materials to withstand the severe corrosion conditions throughout the plant.

As in many other Cosden installations, G-R Heat Transfer Apparatus is helping this plant to operate successfully and efficiently. The G-R equipment installed here includes:

Tubular Residue-to-Crude Exchangers
Tubular Gas Coolers
Twin G-Fin Section Vapor-to-Feed Exchangers
Tar-Heated Steam Generator

Whether your own needs for heat transfer apparatus are for standard or special equipment, be sure to confer with the Griscom-Russell engineers. Their recommendations are *authoritative:* with 80 years of specialized experience . . . *impartial:* with the unequalled line of G-R bare-tube and finned-tube condensers, heaters, coolers and heat exchangers to provide an exactly suitable design for every service . . . *conservative:* with ratings that can be guaranteed.

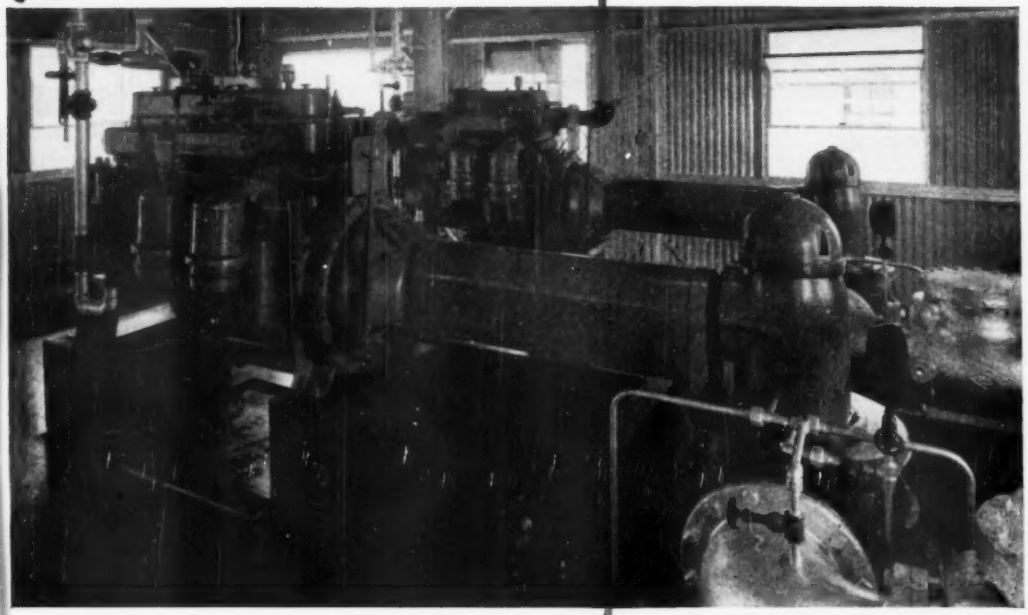
THE GRISCOM-RUSSELL CO.
285 MADISON AVENUE, NEW YORK 17, N. Y.

GR-219

GRISCOM-RUSSELL

IN THIS MID-CONTINENT CYCLING PLANT . . .

WAUKESHAS keep water circulating!



● Engine or power unit—in cycling plant, drilling or service rig, or pumping—you'll find this Waukesha Super-Duty Six (6-WAK) all over the Mid-Continent, and in every oil field. Six cylinders, 6¼-in. x 6½-in., 1197 cu. in. Burning 1000 btu natural gas or propane the stripped engine's maximum continuous output is 224 hp. at 1300 rpm, with a peak of 244 hp. for momentary overloads. It has renewable wet type cylinder sleeves, centrifugal water pump for radiator or tower cooling, overhead valves with renewable guides and hardened seat inserts, 7-bearing crankshaft. Details in Bulletin 1138.

Find out about the Waukesha Super-Duty DIESEL SIX (6-WAKDU) a four-stroke cycle, overhead valve unit, of the same size, that burns all high speed Diesel fuels cleanly, with lively acceleration, high economy, and easier starting—get Bulletin 1115.

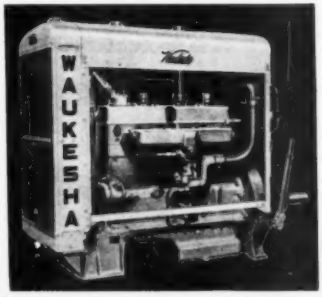
WAUKESHA MOTOR COMPANY, WAUKESHA, WIS.

NEW YORK • TULSA • LOS ANGELES

(Above) Waukesha (6-WAK) Super-Duty Six engines, operating on natural gas

●

Super-Duty Six Gas Power Unit (6-WAKU)



WAUKESHA ...Gas Power

Diesel Power ... POWER

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Port Arthur, Texas
Beaumont, Texas
Houston, Texas

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Texas City, Texas
Freeport, Texas
Corpus Christi, Texas
Brownsville, Texas
Helena, Ark.

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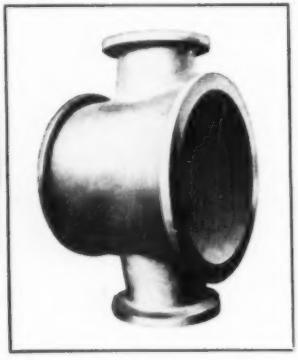
142-foot testimonial to experience



Completely welded nozzle section for heat exchanger; 7'6" high.

You can be sure that the job of building the giant tower shown above would be given only to a manufacturer of proven ability. This 142-foot deisobutanizer tower for the oil industry is indeed a testimonial to the skill, experience and facilities of Combustion Engineering–Superheater, Inc.

But this tower is exceptional in size only. For Combustion has been doing this class of work for many years and has actually produced thousands of pressure vessels and fabricated products not only for refineries in this country but for the oil industry throughout the world.

You would expect this, for the building of pressure vessels requires manufacturing facilities identical to those required for boiler manufacture. As one of the world's largest boiler manufacturers, Combustion Engineering–Superheater, Inc. naturally is well equipped to build virtually all kinds of pressure vessels and fabricated products–particularly those of the larger and more complex types.

Combustion's years of experience in this highly specialized field is available to you. May we have the opportunity to quote on your next requirements?

B-348

COMBUSTION ENGINEERING–SUPERHEATER, INC.

C·E

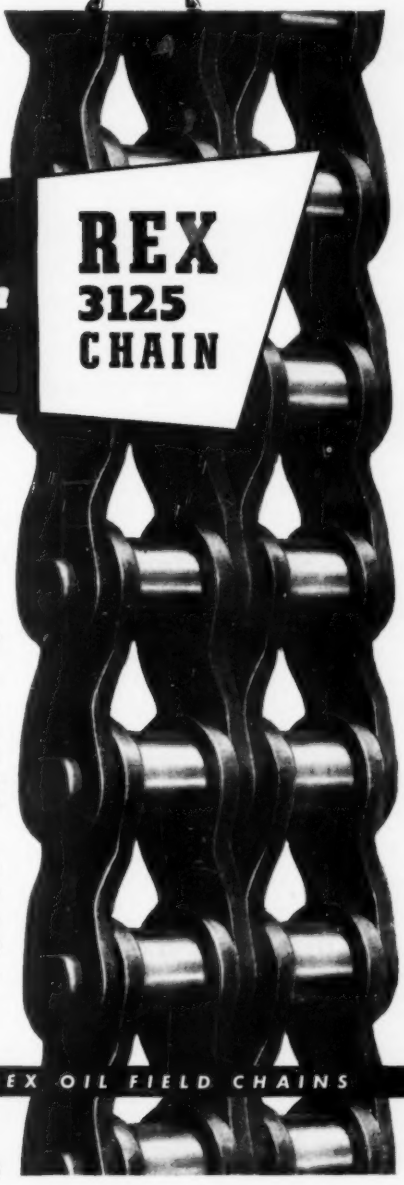
A Merger of Combustion Engineering Company, Inc. and The Superheater Company

200 Madison Avenue • New York 16, N. Y.

ALL TYPES OF STEAM GENERATING, FUEL BURNING AND RELATED EQUIPMENT; ALSO PRESSURE AND VACUUM VESSELS

STRENGTH

you get both with REX 3125 CHAIN



● With its relatively short pitch ... 3⅛" ... Rex 3125 Chain permits operation at far higher speeds than the longer pitch rotary chains, yet it has far greater load-handling capacity than any other drawworks chain.

Available in single and multiple widths, these high speed, high strength chains are sturdily built of highest quality steels.

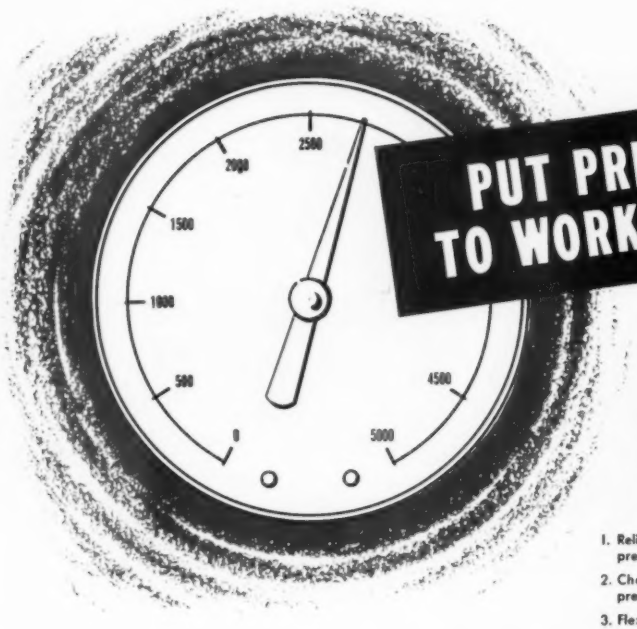
The Rex Unit Link is put together to stay ... to stand up under the terrific stresses and strains of oil field service. All parts, pins, bushings, rollers and side bars are accurately heat treated in the most modern furnaces to develop maximum strength and resistance to wear.

Your Rex Field Engineer or your local supply store will be glad to show you how you can get lower chain cost per foot of hole drilled with Rex 3125 Chains. Or if you prefer, write direct to Chain Belt Company, 1619 West Bruce Street, Milwaukee 4, Wis.

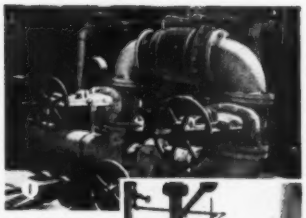
CHAIN BELT REX COMPANY

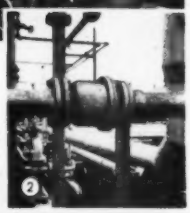
REX OIL FIELD CHAINS

the chains that have grown up with the oil fields



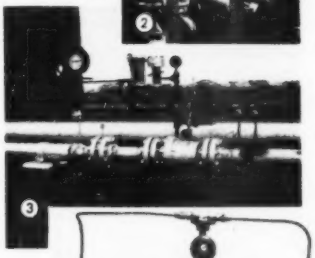
PUT PRESSURE TO WORK FOR YOU

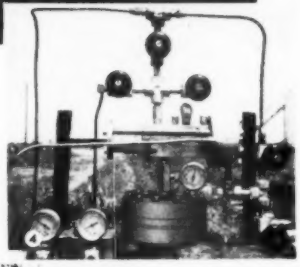




1. Reliever holding back pressure on gas line.
2. Chexflo in gas compressor discharge line.
3. Flexflo automatic shut-off in gas line to heater.

by standardizing... on GROVE valves and regulators





Properly controlled and applied fluid pressures, rather than the mechanical forces of springs, weights or packings, are the outstanding features that characterize Grove designs and products.

The Grove Powreactor Dome principle has revolutionized the design and construction of regulators for high pressure gas, air and other fluids, by eliminating cumbersome springs, weights and levers.

Flexflo and Chexflo valves, resulting from Grove studies of the action of enclosed expanding tubes, effect a positive and unfailing operation never before achieved in the control of pipeline fluids.

The "O" ring Seat-Seal principle, embodied in "T" and "V" series globe-type valves and "F" and "M" series slide valves, has greatly increased the field of usefulness and the pressure ranges of these valve types.

The products illustrated are only a few examples of the flexibility and adaptability of all these exclusive Grove developments. For your control problems, too, Grove can provide regulators and valves of unequalled reliability. Contact the nearest Grove office today, or address your inquiry to:

4. Well Head Protection System, T-series Seat-Seal Valves in manifold.
5. Model 899 Separator Oil Valve.

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310 Thompson Bldg., Tulsa 3, Oklahoma
1930 W. Olympic Blvd., Los Angeles 6, California
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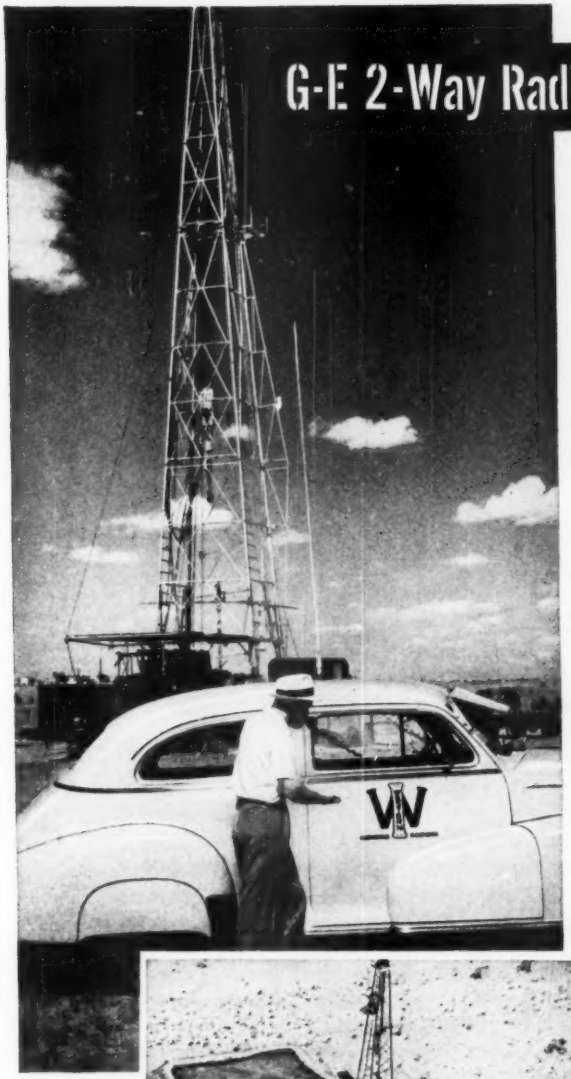
GROVE

GROVE "PUTS PRESSURE TO WORK"

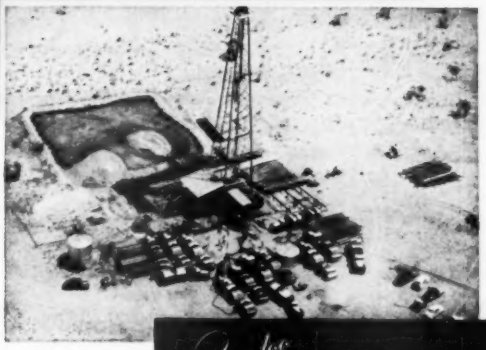
VALVES and REGULATORS



Speeds up acidizing better timing— better service

HERE'S how the Western Company of Midland, Texas provides fast, efficient perforating and acidizing service to drillers in West Texas and New Mexico. Custom-built trucks, with General Electric 2-way radio, carry guns, acid and instruments ready for instant action at well sites. With this equipment crews and field offices are in constant voice communication.

Operators like the way Western engineers reduce "down time" at the well. Western officials like the way G-E radio permits *instant communication* over wide areas—an extra plus that brings in jobs where time is an important consideration.



Reagan County—Largest one-stage acidizing treatment in the Permian Basin. Western trucks shown here are equipped with G-E radio, putting crews in instant touch with company field offices and supply points.

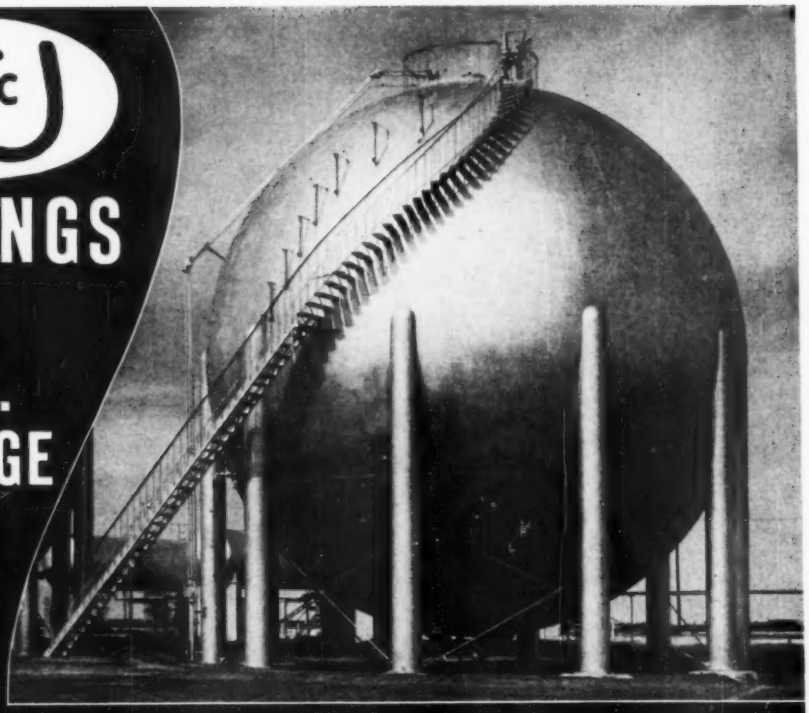
General Electric makes a specialty of radio communication for the oil industry. Call or wire the G-E office nearest you. This booklet FREE on request. *General Electric Company, Room 239, Bldg. 1, Electronics Park, Syracuse, New York.*

Now you can put your confidence in

GENERAL ELECTRIC

S&J

FITTINGS *for* L.P.G. STORAGE



Years ago the major refiners and marketers of petroleum products came to recognize S. & J. fittings for low pressure storage vessels as the leaders in the industry. Through continued research and development and close cooperation with the petroleum industry, we proudly maintain a reputation for quality fittings, not only for low pressure vessels but for high pressure storage as well. S. & J. engineering parallels developments in the petroleum industry, and now that L.P.G. is progressing in giant strides, S. & J. offers quality fittings for the safe storage, transfer, and measurement of Liquefied Petroleum Gases. Your inquiries are solicited.

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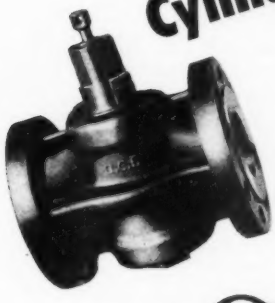
OPERATES WITH EASE

Cylindrical Plug Valve



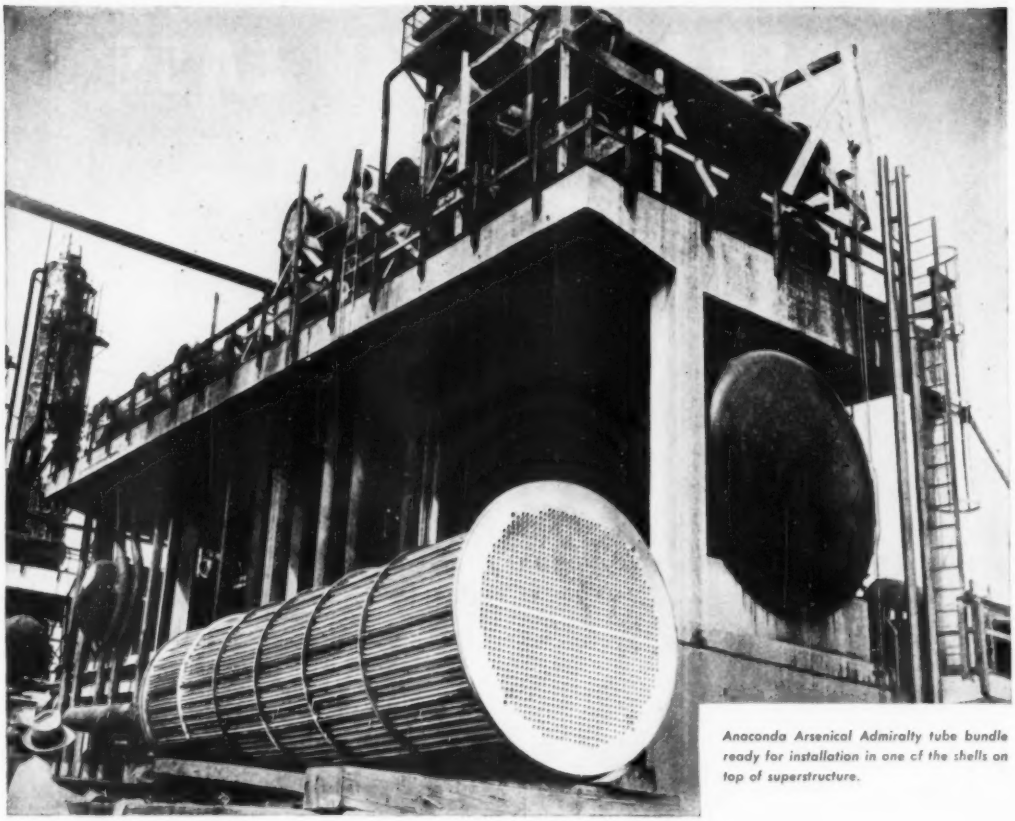
Quick turning is an outstanding advantage of a.c.f. design. No wedging in its seat. The precision-machined Cylindrical Plug, pressure lubricated on all seating surfaces is always free to turn. It could be critically important in your plant. Reason enough to give a.c.f. Lubricated Plug Valves preference.

CYLINDRICAL FULL PIPE AREA LUBRICATED

a.c.f. PLUG VALVES

Representatives in more than 50 Principal Cities.

Ask for catalog 4-OG American Car and Foundry Company, Valve Division, 30 Church Street, New York 8, N.Y.



Anaconda Arsenical Admiralty tube bundle ready for installation in one of the shells on top of superstructure.

Light Hydrocarbon from Fractionating Towers

Handled by ANACONDA ARSENICAL ADMIRALTY TUBES . . .

THE CONDENSERS shown in the photographs above are located at the butadiene plant of Sinclair Rubber, Inc., Houston, Texas. They were built to handle light hydrocarbon from the fractionating towers.

In order to provide the required heat transfer and economical service under the corrosive conditions encountered, the tubes being installed are Anaconda Arsenical Admiralty 439.

This Anaconda Alloy has been manufactured on a commercial basis since 1934. It is but one of 8 standard and several special condenser tube alloys currently produced by The American Brass Company.

This list provides tubes to meet a wide range of heat transfer requirements. The broad metallurgical knowledge and practical experience of our Technical Department is available in helping you make the right selection.

ANACONDA

Anaconda

CONDENSER TUBES

THE AMERICAN BRASS COMPANY

General Offices: Waterbury 88, Connecticut

Subsidiary of Anaconda Copper Mining Company

In Canada: ANACONDA AMERICAN BRASS LTD., *New Toronto, Ont.*

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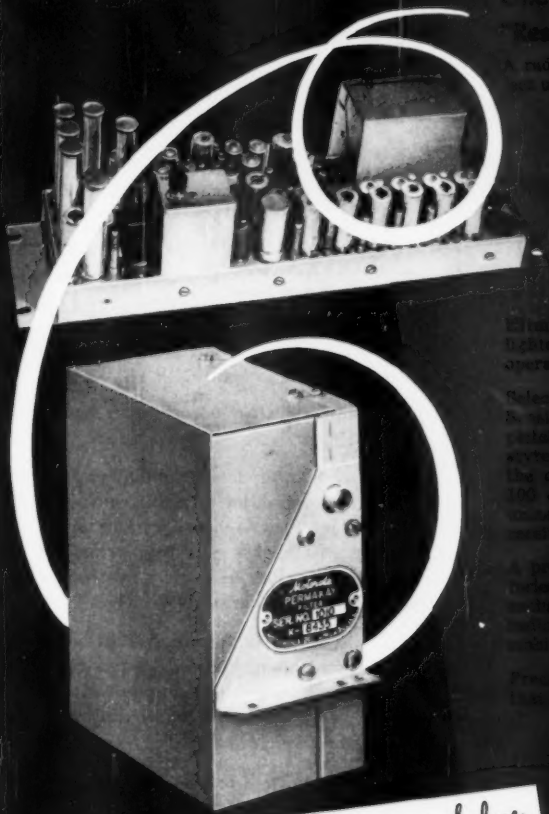
Reduced Maintenance Costs... Increased Serviceability... Guaranteed Selectivity...



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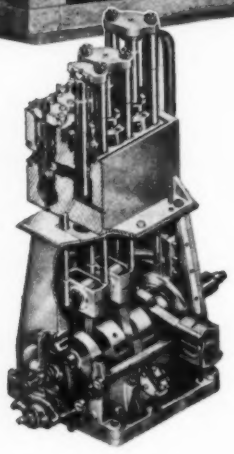
Motorola

"RESEARCH" LINE

FM 2-WAY RADIO

STAYING POWER

An all purpose pump—
The Aldrich Inverted Triplex



Mountains . . . there's rugged grandeur in a range of mountains—and staying power!

There's a similar power in the Aldrich range of high pressure pumps. Every industrial or engineering specialist knows that machinery must have *staying power*—the ability to maintain top performance and high efficiency over long periods of time. They know that interruptions are costly, while *staying power* pays. Aldrich Pumps have that *staying power!*

Take a look at the Aldrich design and construction that make rugged service easy. Note the plungers above the crankshaft, which provide for simplified drive—through speed-reducers or by direct coupling to a driver located on the floor. Expensive foundations are eliminated.

Wherever high pressure pumping is required—and Aldrich Pumps are used—the result is lasting service. Write now for complete technical information. Request Data Sheet 66.

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THE ALDRICH PUMP COMPANY

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The **FIRST** *Name in Reciprocating Pumps*

Put CLEVELANDS On Your Pipeline Trenching Jobs

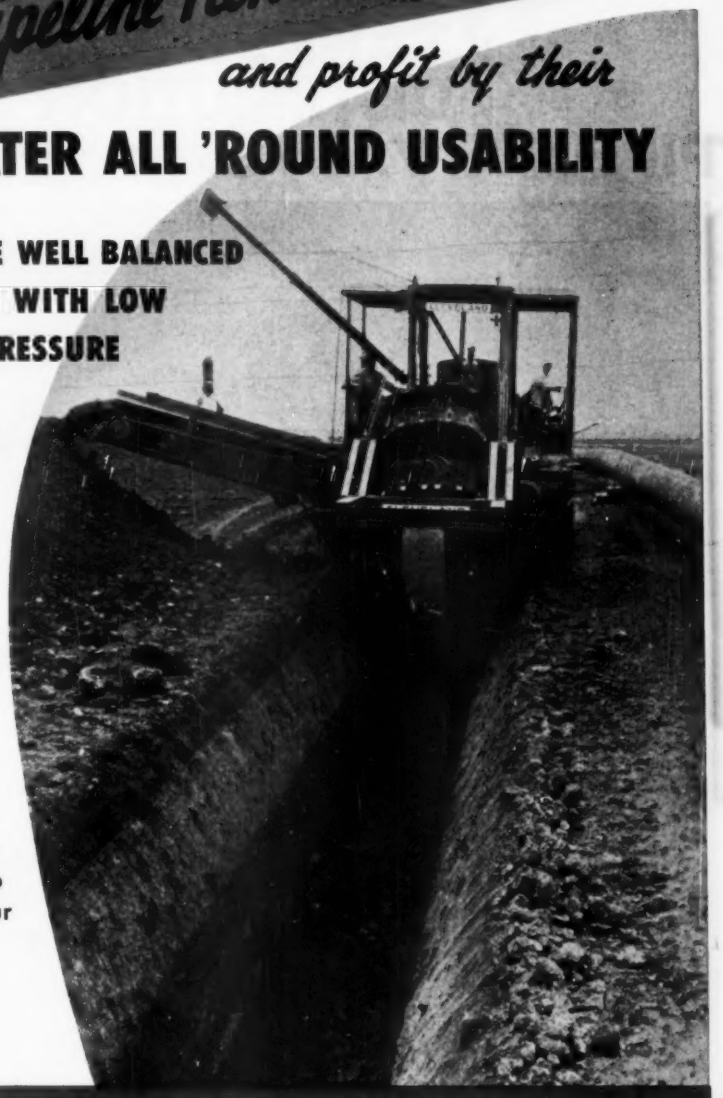
and profit by their

GREATER ALL 'ROUND USABILITY

ALL CLEVELANDS ARE WELL BALANCED ON FULL CRAWLERS WITH LOW GROUND BEARING PRESSURE

This means you profit by CLEVELANDS ability to get in and dig on the tougher pipeline jobs, whether they're in swamps or hills. You profit because CLEVELANDS leave no "plugs" when cutting in or off the line—and are easier to move on and around the job.

Use CLEVELANDS on your next job and cash in on these trenchers that not only cut fast and cheap—but cut MORE of your trench on every job.



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✓ MAIN LINES
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PIPELINE VALVES FOR "PIPELINERS"

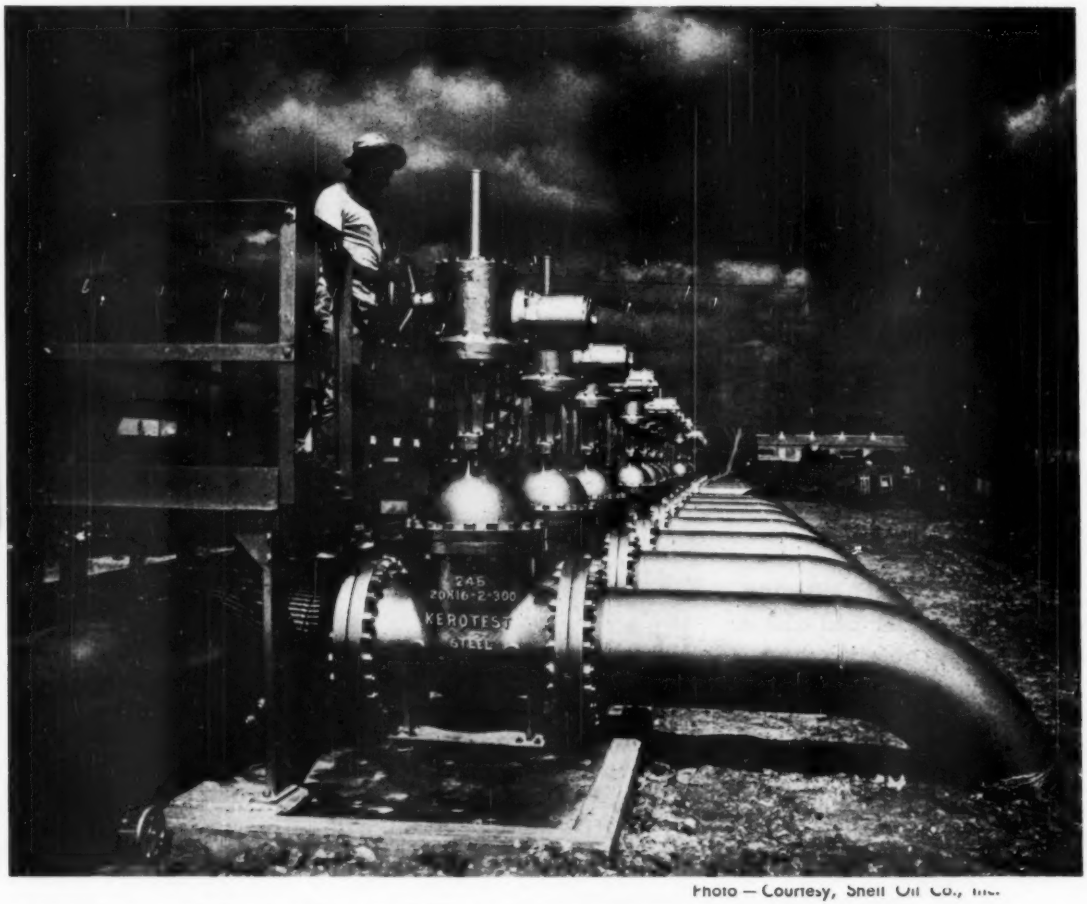


Photo — Courtesy, Shell Oil Co., Inc.

KEROTEST MANUFACTURING COMPANY

KEROTEST

STEEL VALVES

THE RECORD OF GOOD SERVICE IS EVIDENCE OF A SUPERIOR PRODUCT

Kerotest Pipeline Valves are available in rising stem or non-rising stem types. With parallel seat double disc or solid wedge construction for working pressures of — 600, 800 and 1200 pounds with raised face flanges, or for 720, 960 and 1440 pounds with ring joint flanges.

Sizes 8″ to 30″. Hand wheel — gear operated or motor operated.

Kerotest Special Tank Valve for 230 pounds working pressure is a cast steel split wedge type — backed by a splendid service record. This is the valve for your tanks — made in sizes up to 24″. See cut at right.

Hand wheel — gear or motor operated.

Kerotest Valves operate easily. Pressure tight, both directions can be installed in any position.

Horizontal Swing Checks. All Series.

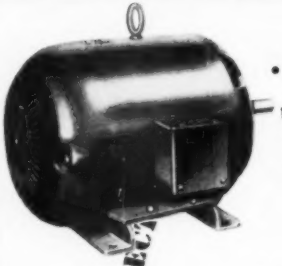
STEEL TANK VALVE

PITTSBURGH 22, PA.

wherever motor hazards lurk... Specify WAGNER PROTECTED MOTORS

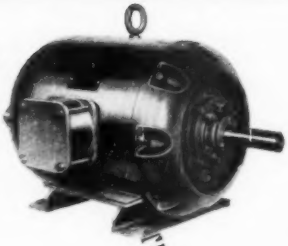
Do you use motors in locations where dirt, filings, moisture, splashing liquids, acid fumes, explosive gases, or other motor hazards lurk? No matter how severe the operating condition, Wagner has the right motor for your purpose—adequately protected against such hazards. Five types of Wagner protected motors are shown below.

• PROTECTED • PROTECTED



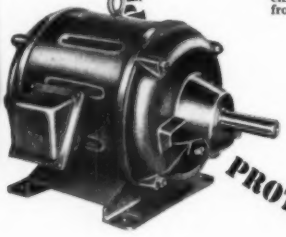
1. Wagner Totally-Enclosed Motors . . . **PROTECTED** against dust, dirt, abrasives, steel chips, filings, acid fumes, and other harmful elements that may damage the windings and bearings.

2. Wagner Explosion-Proof Motors . . . **PROTECTED** to prevent explosion in locations where gasoline, petroleum, naphtha, alcohols, acetone, lacquer solvent vapors, or natural gas are manufactured, used, or handled. Approved by Underwriters' Laboratories for Class I Group D hazardous locations.

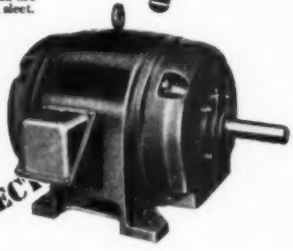


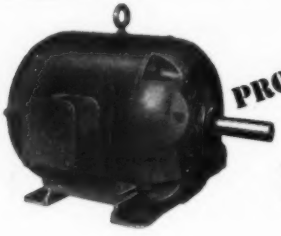
3. Wagner Drip-Proof Motors **PROTECTED** to keep dripping liquids, falling metal chips and other particles from entering the motor.

4. Wagner Splash-Proof Motors . . . **PROTECTED** against splashing or dripping water, oil, or other liquids. They are widely used in exposed outdoor locations, and are completely self-protected against ice, sleet, snow and rain.



5. Wagner Chemical Plant Motors . . . **PROTECTED** to resist the action of acids, fumes, moisture and other harmful elements encountered in chemical manufacturing.





PROTECTED PROTECTED

Bulletin MU-185 gives full information on the complete line of Wagner Motors. Write for your copy today.

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Consult Wagner Engineers on all Electric Motor Problems

BRIDGE BRAKES • POWER AND DISTRIBUTION TRANSFORMERS • MOTORS • UNIT SUBSTATIONS

ELECTRICAL EQUIPMENT AND AUTOMOTIVE BRAKE PRODUCTS

MA9-10

Low Footage Cost

OF APPLYING NO-OX-ID PROTECTION

Achieved with This Fast-Moving Equipment

Because of the speed with which the traveling machine applies NO-OX-ID materials to pipe lines, the footage cost of NO-OX-ID protection is substantially reduced.

The compact, self-propelled unit rides the pipe and moves at a rapid rate, applying both coating and wrapper simultaneously, without the lost motions incident to manual applications. The pipe is cradled into the ditch immediately behind the coating machine. Illustration shows the unit making a hot application of NO-OX-ID 6X and wrapping the pipe with No. 7 NO-OX-IDized reinforced asbestos wrapper.

NO-OX-ID coatings contain chemical inhibitors, bond firmly, seal out all rust-forming moisture. Wrappers, also chemically impregnated and water repellent, aid in maintaining the coating's firm bond, reduce abrasion and soil attachment. All NO-OX-ID materials are nontoxic, cause no aggravating skin reactions.

"PIPING HOT," a new 16 mm sound movie in color on the use of hot-applied NO-OX-IDs by stationary machine, is available to companies, engineering clubs, or technical societies. Write for booking.

Dearborn
Reg. U.S. Pat. Off.

THE LEADER IN RUST PREVENTIVES
AND BOILER WATER TREATMENT

DEARBORN CHEMICAL COMPANY

310 S. Michigan Ave., Chicago 4 • 807-15 Mateo St., Los Angeles
205 E. 42nd St., New York • 2454 Dundas St., West, Toronto

"Sturdy braid-over-braid construction. Resistance to oil and all petroleum fractions."

Those few words are the boiled-down story of R/M's special oil-resistant packing No. 376.

This packing was designed to meet the unusual problems of the oil industry. It is made of highest quality asbestos yarn, braided for extra strength in successive layers, or plies.

Each layer is impregnated with an oil-resistant compound that can be used safely against gasolines, naphthas, solvents, fuel oils, lubricating oils, crude oils, or other petroleum products.

For full information on the complete line of R/M packings for pumps, compressors, and power equipment, talk to your oil-field supply store or write us.

R/M No. 376

. . . a packing for refineries, pumping stations, filling stations

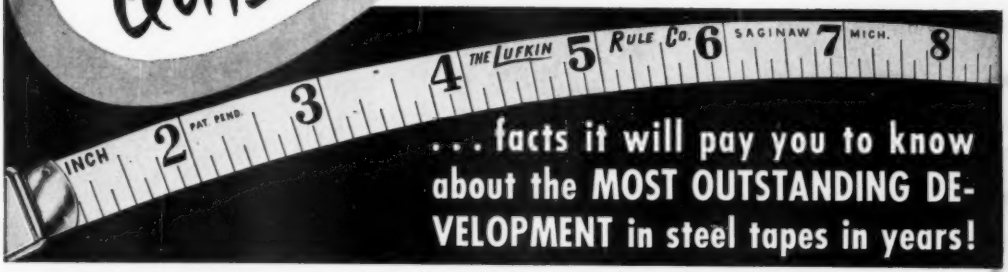
RAYBESTOS-MANHATTAN, INC.

PACKING DIVISION, MANHEIM, PA.

Factories:
Bridgeport, Conn.; Manheim, Pa.; No. Charleston, S.C.; Passaic, N.J.

RAYBESTOS-MANHATTAN, INC., Manufacturers of Packings • Asbestos Textiles Mechanical Rubber Products • Abrasive and Diamond Wheels • Rubber Covered Equipment • Brake Linings • Brake Blocks • Clutch Facings • Fan Belts Radiator Hose • Powdered Metal Products • Bowling Balls

Quick Quiz ON LUFKIN CHROME CLAD STEEL TAPES



. . . facts it will pay you to know about the MOST OUTSTANDING DEVELOPMENT in steel tapes in years!

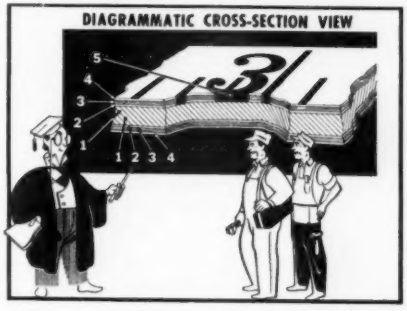
(Numerals Refer To Cross Section View)

Q. Are the markings easier to read in sun or shade?

A. Yes. Jet black markings (5) stand out sharply against the special non-glare satin finish of the heavy chrome plating (4). This finish absorbs light instead of reflecting into your eyes. Easy on the eyes—less stooping and squinting. Will not crack, chip or peel.

Q. Are the markings more durable?

A. Yes. The black markings bonded to steel are sunk below the hard, smooth chrome surface (5) thus protecting them against wear—even dragging over concrete or gravel. No metal is etched away. The markings remain easy to read even after years of rough usage.



Q. Are the lines tougher—more durable—more resistant to kinks and breakage?

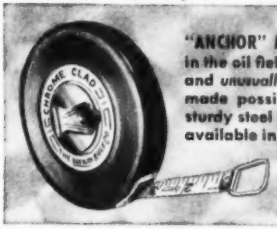
A. Yes. The heavy chrome plating adds to the toughness of the hardened steel line (1). Kinking and line breakage are rare indeed.

Q. Do they resist rust and corrosion?

A. Yes. A rust-resistant coating (2) plus multiple coats of electroplating (3) give remarkable protection against rust and corrosion. Years of grueling service in tropical damp, sea water, mines, oil fields and chemical plants have proven them resistant to rust and corrosion under conditions no other tapes can withstand.

Call for Lufkin Chrome Clad Steel Tapes at your dealers and prove these statements for yourself.

***Buy* steel tapes with easy-to-read markings that are durable**



"ANCHOR" Model . . . Preferred for heavy duty in the oil fields because of its greater durability and *unusually* large, easy-to-read figures, both made possible by the full ½" width of the sturdy steel line. Permanent jet black markings available in either the English or Metric system —or both. Hand-stitched genuine leather case protects rust resistant steel liner.

Buy LUFKIN

PRECISION TOOLS • TAPES • RULES FROM YOUR DISTRIBUTOR

THE LUFKIN RULE CO.

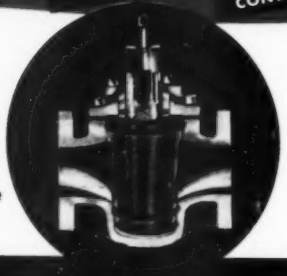
Saginaw, Michigan • New York City • Windsor, Canada

AUTOMATIC

SELF-SEALING · SELF-ACTING · SELF-THINKING · CONTINUOUS PRESSURE · SPLIT-SECOND ACTION

Greatest improvement in history of Nordstrom valves

—gives effect of improved design without mechanical change



Tried, tested, proved in laboratory, field and plant

Keeps Nordstrom valves in state of perfect lubrication

AN *energizable* LUBRICANT

to seal Nordstrom valves automatically and continuously

Fully automatic lubrication for Nordstrom valves is here! Introduction of Rockwell *Hypermatic* lubricant marks the greatest advancement in the valve industry since the invention of Nordstrom valves 30 years ago. Hypermatic is the first and only genuine automatic lubricant.

Now you can make deep cuts in your valve maintenance cost because your lubrication crew need devote only 1/10, 1/20, 1/50, up to 1/100 as much time to re-lubrication.

Your Nordstrom valves will give better service with less cost because each one will be automatically maintained in a condition of 100% lubrication, even in event of considerable neglect.

Leakage will be prevented because Hypermatic both seals and lubricates with split-second action and positive certainty.

Unlike any other lubricant, Hypermatic is compressible and expansible. Self-powered energy is created within the lubricant merely by turning the lubricant screw or using a grease gun. This energy then serves as a powerful force-feed. Almost twice as much Hypermatic can be compressed into the valve's lubricant chambers. The pressure is retained, not for days, but for months, if the valve is not operated. If frequently operated, Hypermatic will retain its pressure for scores of turns longer than if non-automatic lubricant is used.

NOTHING TO BUY EXCEPT THE LUBRICANT

Instead of resorting to the use of extraneous devices or endeavoring to use variable line pressure, Hypermatic provides a new system of lubrication which gives the effect of a vastly improved valve design. You don't have to invest a single cent in mechanical devices. You don't even have to purge the old lubricant. Simply switch to Hypermatic and apply it to your present Nordstrom valves. It will displace the old lubricant.

Your Nordstrom valves will use less Hypermatic than non-automatic lubricant because Hypermatic creates, by its flexible nature, a "spring-action" which to a great extent prevents over-lubrication and under-lubrication.

IT COMPRESSES

Like the action of a door-check, Hypermatic compresses to a fraction of its volume when the lubricant is forced in. This stores up energy for future use.

ROCKWELL

Hypermatic

TRADE MARK

LUBRICANT

PATENTS APPLIED FOR

FOR NORDSTROM VALVES

IT EXPANDS

When the valve needs lubricant to seal a leak, its inherent energy forces it to expand and seal the valve seat. It feeds into any void instantly.

LUBRICATION

MAN-HOURS SAVED · TWICE THE STORAGE · MULTIPLIED VALVE LIFE · GALLING ELIMINATED · SAVES LUBRICANT

Switch to Hypermatic—stocks now available.

Place your order immediately for this new, amazing automatic lubricant. A variety of types is available to meet approximately 75 per cent of Nordstrom valve services. Field demonstrations are now being arranged.

NORDSTROM VALVE DIVISION—*ROCKWELL MANUFACTURING CO.*

400 North Lexington Avenue • Pittsburgh 8, Pennsylvania

Atlanta, Boston, Chicago, Columbus, Houston, Kansas City, Los Angeles, New York, Pittsburgh, San Francisco, Seattle, Tulsa . . . and leading Supply Houses

Export: Rockwell Manufacturing Company, International Division, 7701 Empire State Building, New York 1, New York

Mail this coupon for HYPERMATIC Bulletin

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Rockwell Manufacturing Co.
400 North Lexington Ave., Pittsburgh 8, Pa.

Send Hypermatic Bulletin and Specifications

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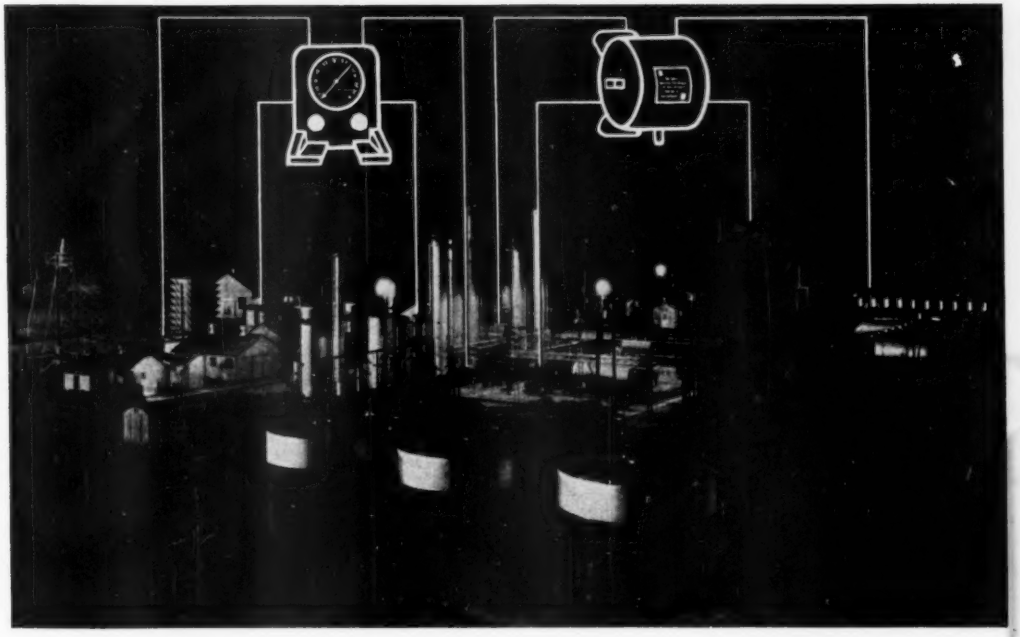
Easier dish washing... you'll find the secret in petroleum

It may seem like a long trip to your dishpan, but a good share of the "soapless soaps" you use started deep in the earth in an oil well.

These new cleaners, called detergents, actually make water "wetter"... attract dirt and grease almost like a magnet. They make dishes sparkle, work well with all fabrics in hard or soft water, clean cars, and they have many other home and industrial uses.

The practical means of making detergents from oil came out of Standard of California research... by risking substantial sums for experimentation and development. The results: new products to make your work easier, new manufacturing and selling jobs, a company better able to serve you and all the West.

STANDARD OIL COMPANY
OF CALIFORNIA
plans ahead to serve you better



These "ghosts" on your payroll save you time, money and manpower

The modern method of conveying pressure measurements from distantly located points in your plant to central control stations is provided by either Ashcroft Pneumatic or Microsen Electrical Pressure Transmission Systems. Safe, accurate and economical, *they bring to one operator a quick and complete picture of all the important process variables you employ.*

The result of years of experience in manufacturing pressure gauges and electrical instruments, both transmission systems are simple to install, easy to maintain, include many advantages of tried and proven design.

The specific requirements of your application will largely determine whether the Ashcroft Pneumatic or the Microsen Electrical system is most suitable.

The Ashcroft Pneumatic System, designed for distances *up to 1000 feet*, measures and indicates any pressure up to 50,000 p.s.i.—including compound or straight vacuum ranges—and has an overall accuracy of within ½ of 1 per cent throughout the scale. Consisting of an Ashcroft Transmitter and one or more Ashcroft Indicating or Recording Receiver Duragauges, this pneumatic system avoids long, high-pressure lines. The receiver gauges are actuated by low-pressure air—proportional to the original pressure—delivered through small size tubing. Inflammable, viscous, poisonous or corrosive liquids or gases are confined to their source.

The Microsen Electrical System is designed for distances up to 1000 feet *and greater*. The pressure measurements are transmitted to a central control station through simple electrical wiring. Long, high-pressure lines, which may leak or fracture and cause serious damage, are avoided. The transmitting system is a conventional, direct current, two wire circuit using any available wire size and the power supply can be any of the normally used circuits commonly available in industrial plants.

Since the electrical output from the Microsen Transmitter is directly proportional to the pressure, any linear electric meter of appropriate sensitivity may be used as a receiver.

MICROSEN ELECTRICAL PRESSURE TRANSMITTER

For complete information, write for the Ashcroft Pneumatic and the Microsen Electrical Pressure Transmission Bulletins.

PRODUCTS OF

MANNING, MAXWELL & MOORE, INC.

STRATFORD, CONNECTICUT

Makers of 'Ashcroft' Gauges, 'Hancock' Valves, 'Consolidated' Safety and Relief Valves, 'American' Industrial and 'Microsen' Electrical Instruments. Builders of 'Shaw-Box' Cranes, 'Budgit' and 'Load Lifter' Hoists and other lifting specialties.

ASHCROFT PNEUMATIC PRESSURE TRANSMITTER

Authorized Fuel Injection Service

the Whole World Over

Many years ago, American Bosch saw that one of the greatest contributions it could make to the progress of Diesel power was to establish a world-wide system of expert fuel injection service facilities. To achieve this, American Bosch pioneered an intensive program of factory training which still continues. As a result, Diesel users can buy American Bosch equipped engines with the confidence that factory-quality fuel injection service will always be readily available whenever needed.

IN THE U. S. AND CANADA ALONE THESE 86 AUTHORIZED SERVICE STATIONS ARE CONVENIENTLY LOCATED

ALABAMA
Birmingham 3, Birmingham Electric Battery Co., Ave. B & 23rd St. S.

ARIZONA
Phoenix, Charlie C. Jones Battery & Electric Co., 318-322 W. Jefferson St.

CALIFORNIA
Eureka, Diesel & Electric Specialties, 198 West 5th St.
Fresno, Winther Bros., 612 Divisadero St.
Los Angeles, Diesel Injection Equipment Co., 2348 East Eighth St.
Los Angeles 21, Magneto Sales & Service Co., Inc., 751 Towne Ave.
Sacramento 6, Langner & Rifkin, 1116-22 15th St.
San Diego, Magneto Sales & Service Co., 1254 Kettner Boulevard
San Francisco 3, Furrer & Uster, Inc., 225 Seventh St.
Wilmington, Diesel Control Corp., 218 North Marine Ave.

COLORADO
Denver 3, Central Supply Company, 1171 Lincoln St.

DISTRICT OF COLUMBIA
Washington, Diesel & Ignition Service Inc., 925 Girard St., N. E.

FLORIDA
Jacksonville, Patten Sales Co., Inc., 1021 Hogan St.
Jacksonville 1, Spencer Electric, Inc., 40 W. Beaver St.
Miami 36, Florida Diesel Service Co., 1930 N. Miami Ave.
West Palm Beach, Sutcliffe's Electric Co., 222 North Olive Ave.

GEORGIA
Atlanta 3, Auto Electric & Magneto Co., 477 Spring St. N.W.

IDAHO
Lewiston, Osterman Diesel & Electric Co., 1610 Main St.

ILLINOIS
Chicago 16, Illinois Auto Electric Co., 2011-37 Indiana Ave.

INDIANA
Indianapolis 4, Gulling Auto Electric Inc., 450 N. Capitol Ave.

IOWA
Des Moines, Electrical Service & Sales Co., 1313 Walnut St.

KANSAS
Wichita 2, E. S. Cowie Electric Co., 230 S. Topeka Ave.

KENTUCKY
Louisville, Schaaf Auto Electric Co., 439 East Broadway

LOUISIANA
New Orleans 13, John M. Walton, Inc., 1050 Carondelet St.
Shreveport, Vaughn Tractor & Auto Parts Co., 224 Airport Drive

MAINE
Portland 5, Portland Tractor Co., Inc., 803 Forest Ave.

MARYLAND
Baltimore 1, Parks and Hull Automotive Corp., 1033 Cathedral St.

MASSACHUSETTS
Boston 15, W. J. Connell Company, 121 Brookline Ave.
Boston 10, Wharf Machine & Electric Co., Inc., Fish Pier Road
Fairhaven, Hathaway Machinery Co., Inc., Hathaway-Bralay Wharf

MICHIGAN
Detroit, Knorr-Maynard, Inc., 5743 N. Woodward Ave.

MINNESOTA
Minneapolis, Diesel & Magneto Service Co., 3301 E. 26th St.
Minneapolis 2, Reinhard Bros. Co., Inc., 11 South 9th St.

MISSISSIPPI
Jackson, Vaughan Tractor & Auto Parts of Mississippi, Highway 80 West

MISSOURI
Kansas City 8, Electrical & Magneto Service Co., 2538 Grand Ave.
St. Louis 23, Diesel Fuel Injection Service Co., 9806 So. Broadway
St. Louis 3, Electric Parts and Service Co., 2900 Washington Blvd.

MONTANA
Billings, Original Equipment, Inc., 423 North Broadway

NEBRASKA
Omaha 2, Carl A. Anderson, Inc., 16th & Jones

NEW JERSEY
Newark 2, Tire Trading Company, Inc., 239 Halsey St.

NEW YORK
Brooklyn 9, E. A. Wildermuth, Inc., 1102 Atlantic Ave.
Bolivar, Bolivar Magneto Co., 60 Wellsville St.
Buffalo 8, Hettrich Electric Service, 1032 Ellicott St.
New York 23, The Durham Co., Inc., 17 West 60th St.
Syracuse 4, F. A. Crossman, Inc., 943 West Genesee St.
Troy, Ehrlich Electric Service, Inc., 200 Fourth St.
Utica, Stiefvater Electric Co., Inc., 320-322 Lafayette St.

NORTH CAROLINA
Charlotte, Carolina Rim & Wheel Co., 312 N. Graham St.

OHIO
Cincinnati, Tri-State Distributing Corp., Broadway at Eight
Cleveland 14, The Cleveland Ignition Co., 1301 Superior Ave.
Columbus 15, Columbus Ignition Co., 211 Neilston Ave.
Lisbon, Diesel Service Co., 234 East Washington St.

OKLAHOMA
Oklahoma City 2, American Electric-Ignition Co., 124 N. W. 8th St.
Tulsa, Magneto Ignition Company, 701 West 5th St.

OREGON
Klamath Falls, Diesel & Electric Service, 1950 So. Sixth St.
Pendleton, Eds Magneto & Diesel Co., S. W. 18th & Court Sts.
Portland 14, Automotive Products, Inc., 1700 Southeast Grand Ave.

PENNSYLVANIA
Hazleton, Anthracite Injection Co., 30th & North Church Sts.
Philadelphia, Sullivan Brothers, 1718 Fairmount Ave.
Pittsburgh 13, Automotive Ignition Co., Inc., 4917-4919 Baum Blvd.

SOUTH CAROLINA
Charleston, Diesel Fuel Injection Service, Adger's Wharf, P. O. Box 512

TENNESSEE
Knoxville, Diesel-Magneto Service Co., 1209 Island Home Ave.
Memphis 4, Automotive Elec. Service Co., 982 Linden Ave.

TEXAS
Dallas 1, Beard & Stone Electric Co., Inc., 2101 Bryan St.
El Paso, Oakes Battery & Electric Co., 423 Texas St.
Houston 1, Beard & Stone Electric Co., Inc., 805 Polk Ave., P. O. Box 1717
Odessa, Electric Service & Supply, P. O. Box 1471

UTAH
Salt Lake City 2, Koepsel & Love, 47 East 7th South St.

VIRGINIA
Norfolk, Diesel Injection Sales and Service, 710 Union St.
Richmond, C. H. Woodward Electric Co., Inc., 709 W. Broad St.

WASHINGTON
Rosalia, Van's Diesel Electric Co., P. O. Box 560
Seattle, Sunset Electric Co., 300 Westlake North, P. O. Box 3148
Spokane, Sunset Electric Co., First & Adams Sts.
Walla Walla, Industrial Products Co., 610 N. Ninth St.

WEST VIRGINIA
St. Albans, Beard Engine Equipment Co., 513 Fourth St.

WISCONSIN
Milwaukee 2, Wisconsin Magneto Company, 918 N. Broadway

CANADA
Calgary, Hutton's, 131—11th Ave., W.
Edmonton, Smith Battery & Auto Electric, 10125—105th St.
Montreal, International Electric Co., Ltd., 1037 Bleury St.
Regina, Electric Motor Service, 1734 Broad St.
Toronto, A. Cross & Co., Ltd., 45 Elm St.
Toronto, Auto Electric Service Co., Ltd., 1009 Bay St.
Vancouver, Jeffree & Jeffree, Ltd., 775 Homer St.
Vancouver, Macfarlane & Co., 1257 Seymour St.
Vancouver, Vivian Engine Works, Ltd., 1660 Station St.
Winnipeg, Brown & Murray, Ltd., 237-241 Fort St.

ALASKA
Juneau, Parsons Electric Company, Second & Seward Sts., P. O. Box 1749

HAWAIIAN ISLANDS
Honolulu, Honolulu Iron Works Co., P. O. Box 3140

PUERTO RICO
San Juan, General Farm Equipment Co., Tras-Miramar, Santurce, P. O. Box 3588

Complete list of Foreign service agencies available on request

American Bosch Corp.
Springfield 7, Mass.

American Bosch

America's greatest name in fuel injection equipment

Like some tortoises and turtles, Kenworth trucks are noted for their long life. It is no longer even a novelty for a truck operator to own a Kenworth truck which has passed a million miles of service and is still going strong. This is due, in part, to the fact that, again like the turtle, a Kenworth truck carries a protective armor wherever it goes — tough sheet metal which stands up longer under harder service. But the fundamental reason behind the long life of Kenworth trucks is sound engineering which builds for the job in every detail — from frames to seats, from outside mounted air cleaners to heavy duty front wheel studs, from threaded spring pins to continuous full length door hinges. Because Kenworth trucks are built for the job they last on the job — and

Here's more **WORTH**

to **KENWORTH.**

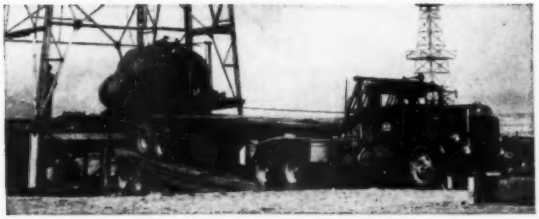
Built for the job

LONG LIFE

KENWORTH

TRUCKS ★ BUSES

FACTORY AND HOME OFFICE: SEATTLE, U. S. A., DISTRIBUTORS IN THE UNITED STATES AND MOST FOREIGN COUNTRIES



Leading oil field operators count on heavy-duty Kenworth trucks, such as this Model 524, to transport their oil field equipment, supplies and finished products efficiently to and from locations, on and off the highway. Dependability of performance is reflected in low operating costs.

You can't buy A LOWER COST-PER-YEAR VALVE than

HOMESTEAD-REISER *Self-Sealed* LUBRICATED PLUG VALVES

They are the lowest-priced, full-port-area plug valves in their pressure and temperature range

And they *outlast* all other lubricated plug valves in their class. Every one of their many outstanding advantages including

100% area of standard pipe
100% lubricant seal around ports
Extreme economy of lubricant
Single lubricant for wide variety of applications, and
Self-sealing automatic adjustment for wear

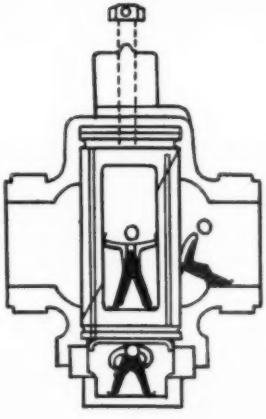
. . . are features asked for by engineers and operating men of industry.

Proof of their long, economical, dependable performance has been established in practically every industry during the past seven years. And at their new low price, they are more than ever your lowest cost-per-year fluid control.

Why not send today for your free copy of Valve Reference Book No. 39-5? *It shows sizes, types and pressure ratings for Homestead-Reiser Valves.*

How the "*Self-Sealed*" Principle Works

In addition to a full lubricant seal around the ports and around the top and bottom of the valve, the wedge-action of the plug under line pressure, constantly presses the finely-finished surfaces of the plug outward against the seating surfaces of the body. This self-sealing action keeps the plug surfaces in contact at all times with the mirror-like bore of the body. The plug thus automatically adjusts itself for wear, assuring extra long life and maximum leakless service.



Write today for Reference Book 39—Section 5

HOMESTEAD VALVE MANUFACTURING CO.

"Serving Since 1892" P. O. Box 403, Coraopolis, Pa.

from plan to plant

CHEMICO'S ALL-INCLUSIVE SERVICE OFFERS IMPORTANT ADVANTAGES FOR THE DESIGN AND CONSTRUCTION OF HEAVY CHEMICAL PLANTS

FLOW DIAGRAM
TYPICAL CHEMICO CONTACT
SULFURIC ACID PLANT

***Here are the broad,* start-to-finish *steps Chemico takes to make certain that every plant they build will be a* profitable investment.**

INITIAL INVESTIGATION — Each Chemico project is specifically planned to meet individual needs. Before engineering designs are started, Chemico checks type of available utilities, elevation of plant site, soil conditions . . . in fact, every factor that might influence the design of the plant.

PROVED PROCESSES — Chemico has pioneered in the development of improved processes that help increase production quality and quantity. Chemico will either adapt these advanced, plant-proved processes to your particular problem . . . or, in some cases, develop entirely new processes.

MAN-HOUR MATHEMATICS—Carefully calculated, too, are the means to make every man-hour most productive . . . and to reduce over-all manpower requirements through automatic operation, centralized control and efficient plant layout.

MINIMUM MAINTENANCE — The process used, the selection of equipment, the plant layout—all are analyzed with an eye to simplifying maintenance problems. In a Chemico-built plant, repairs are never "hard to get at".

COMPLETING THE CONTRACT — Chemico makes certain that over-all guarantees are met before turning over the plant to the purchaser. And Chemico trains the operating crew to assure smooth-running, efficient operation.

These add up to *one contract—one responsibility.* During the past 35 years, Chemico has built hundreds of heavy chemical plants throughout the world. That's proof of Chemico's successful experience.

CHEMICAL CONSTRUCTION CORPORATION

EMPIRE STATE BLDG., 350 FIFTH AVENUE, NEW YORK 1, N. Y.

EUROPEAN TECHNICAL REPRESENTATIVE
CYANAMID PRODUCTS, LTD., BRETTENHAM HOUSE, LANCASTER PLACE, LONDON W. C. 2, ENGLAND
CABLES: CHEMICONST, NEW YORK

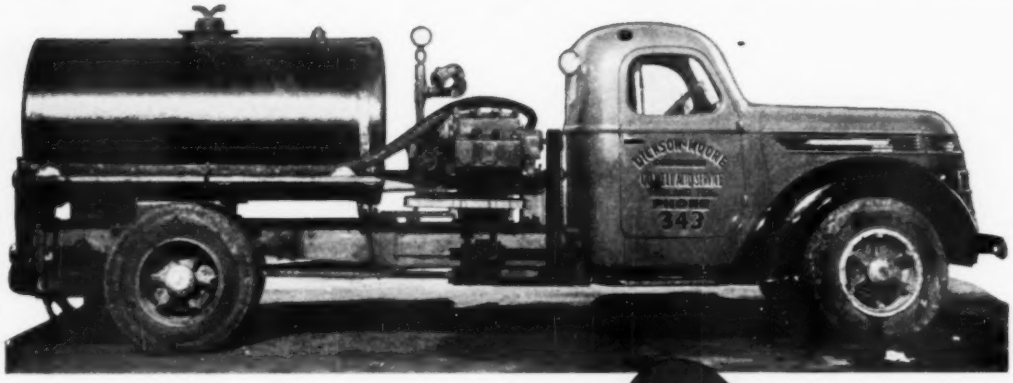
Chemico Plants are Profitable Investments

CC 179

POWER....

when you want it...where you want it

DIRECT FROM YOUR TRUCK MOTOR



Power on the job -- in the field -- wherever your truck can travel -- is the most economical, the speediest!

Simply put this power take-off on your standard truck chassis and transmit the full power of the truck motor by V belt or chain to any equipment that can be installed back of the cab.

The PTO turns the same number of revolutions and in the same direction as the drive shaft -- either forward or reverse. In effect, it becomes a section of the driveshaft.

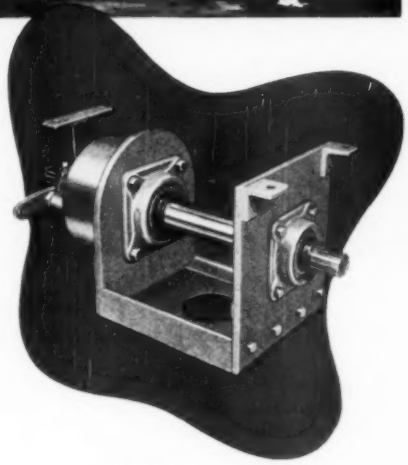
This same power take-off, basically unchanged, yet with improvements and refinements, has been manufactured and in service for nearly twenty years. It has been fully field tested and proven. Thousands of these units are giving satisfactory service over the country.

Typical users: Public utility companies, city, county and state highway departments, railroads, oil companies, oil producers, farmers, contractors.

Get full specifications of this equipment — Send for illustrated folder, CG-10.

CEMCO INDUSTRIES, Inc., GALION, OHIO

Manufacturers of hydraulic operated tailgates, underbody hoists and power take-offs.



CEMCO MODEL D-1
Hand lever in cab enables driver to operate PTO from cab.

CEMCO *Split-Shaft*

POWER TAKE-OFF

WICKWIRE ROPE

A PRODUCT OF CF&I

Ask any user . . . you'll find them everywhere

In scores of industries, users of Wickwire Rope have developed an affectionate respect for its performance, safety and long life. And, for true economy, they use Wickwire's WISSCOLAY® *Preformed*. It lasts longer — is easier to cut, splice and install. It's kink-resistant and safer to handle. Wickwire Distributors and Rope Engineers, in key cities everywhere, are prepared to render prompt service in meeting your wire rope needs. Wickwire Rope Sales Office and Plant — Palmer, Mass.

IN THE EAST—Wickwire Spencer Steel Div. of C. F. &I.
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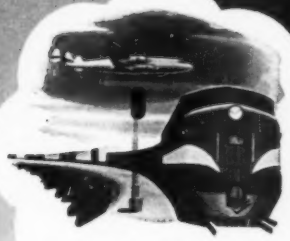
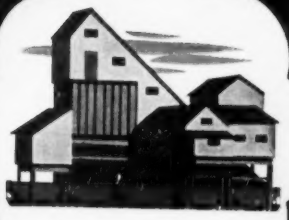
IN THE ROCKIES—The Colorado Fuel and Iron Corp.
Continental Oil Bldg., Denver, Colo.
ON THE WEST COAST—The California Wire Cloth Corp.
1080—19th Ave., Oakland 6, Cal.

LOGGING



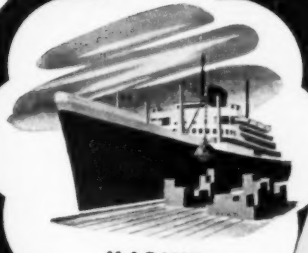
TRANSPORTATION



MINING

PETROLEUM

MANUFACTURING



MARINE

CONSTRUCTION

Read Between the Lines and You'll Know Why NAYLOR PIPE is Outstanding in Pipe Line Service

• Its light weight makes Naylor Pipe easy to handle and install.

• Naylor's exclusive Lockseam Spiralweld provides safety features not found in ordinary light-weight pipe.

• The spiral truss assures added collapse strength for lines in vacuum service.

• Naylor's accurate diameter and true cylindrical form help speed installation.

• The standard weight ends simplify connection.

• The Naylor structure is ideal for surface casing use. Naylor threaded surface casing is particularly effective where field welding is impractical.

Specify NAYLOR PIPE on Applications Like These . . .

Gas and oil lines • Gas and oil gathering lines
Water lines • Sludge lines • Vacuum lines • Syphon pipe • Tank gauge pipe • Tank swing pipe
Threaded surface casing

Sizes from 4" to 30" in diameter — thicknesses from 14 to 8 gauge. All types of fittings, connections and fabrication.

Call our distributors or write direct.

NAYLOR

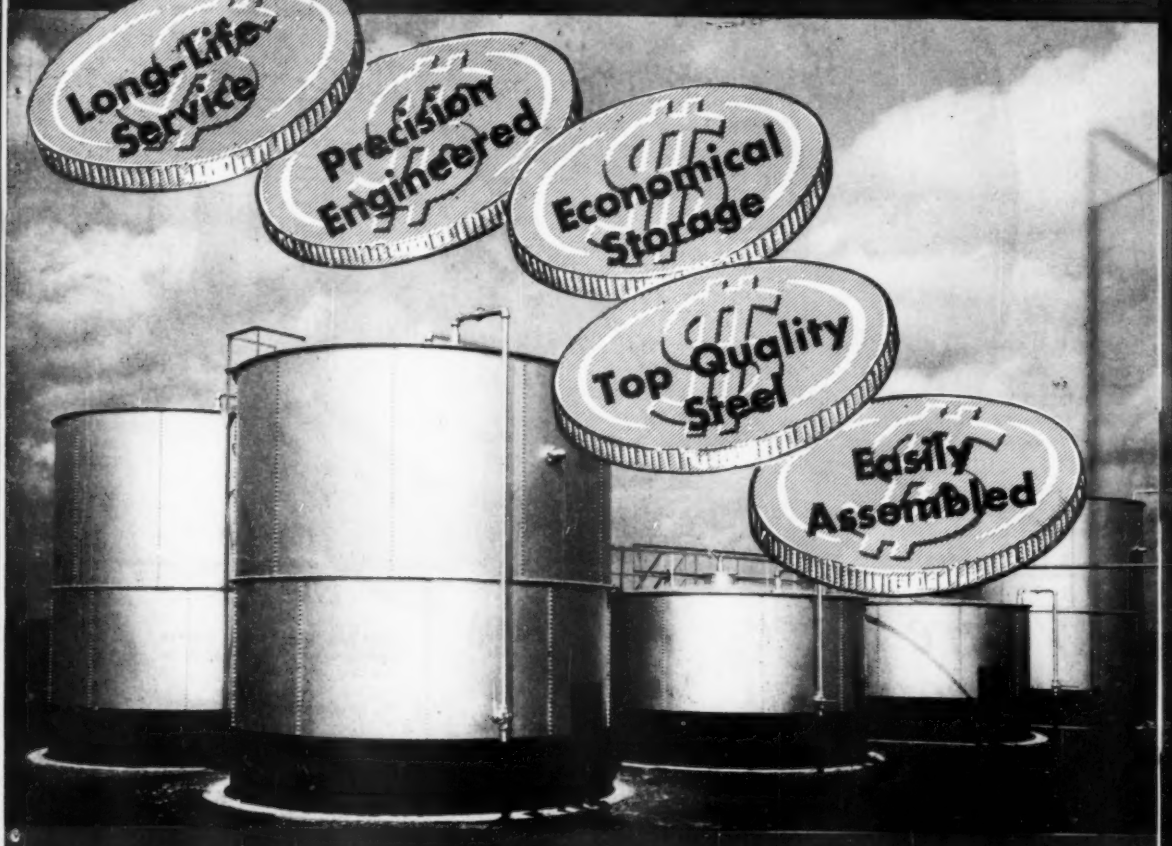
NAYLOR PIPE COMPANY • 1232 East 92nd St., Chicago 19, Ill. • New York Office: 350 Madison Ave., New York 17, N. Y.

Mid-Continent Supply Company • Ft. Worth, Texas and Branches • Exclusive distributors in Mid-Continent and Gulf Coast Areas

Get the EXTRA VALUE of

COLUMBIAN

RIVETED STEEL TANKS



COLUMBIAN STEEL TANK CO., Kansas City, Mo.

Read Between the Lines and You'll Know Why NAYLOR PIPE is Outstanding in Pipe Line Service

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Sizes from 4" to 30" in diameter — thicknesses from 14 to 8 gauge. All types of fittings, connections and fabrication.

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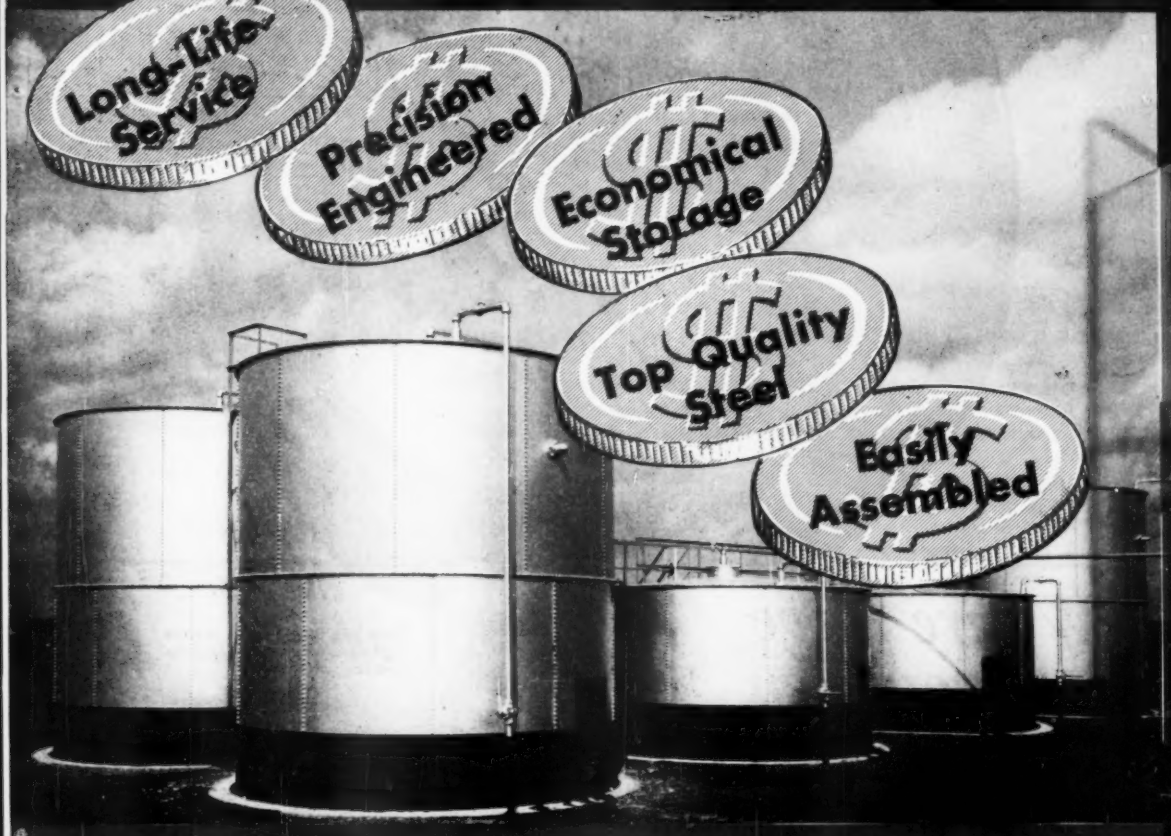
COLUMBIAN



TANKS FOR THE WORLD

COP-NIC COPPER-NICKEL ALLOY

COLUMBIAN STEEL TANK CO., Kansas City, Mo.

Where have you seen THIS *face before?*

New fact-filled catalog will be sent to anyone requesting it on company letterhead.

It's the honest face of a good instrument—a familiar face because it has been widely chosen by oil men who know that the success of their equipment rests in no small part on the accuracy of its pressure indication.

Often that face is the face of a veteran—a Marsh Gauge that has seen many years of tough going. But, as you trace back over the Marsh Gauges you have known, can you recall a single one of them that has ever failed to do its job right?

To build such a gauge requires more than good design and construction. It requires a fund of practical knowledge that can be acquired only in the vast proving ground of the oil country—the kind of knowledge that Jas. P. Marsh Corporation has been accumulating for more than 80 years.

JAS. P. MARSH CORPORATION, Dept. L, Skokie, Illinois

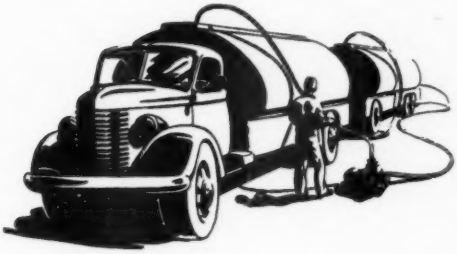
THE MARSH BRANCH *plant at Houston offers shipment from stock and facilities for repairing all makes of gauges.*

MARSH GAUGES

OAKITE
Specialized Cleaning

Oakite solves another tough cleaning job

look at this record:



PROBLEM: A Midwest company had to clean the interior of a 3000 gallon insulated asphalt trailer before making welding repairs. About 2 inches of asphalt had to be removed from the bottom of the truck, heating pipes and walls of the trailer.

SOLUTION: The Oakite Man was called in. He dumped in 800 gallons of hot water. Added recommended amount of Oakite Composition No. 19, and mixed into solution. Pump-circulated Oakite cleaning solution from top manhole back through bottom of trailer using flexible steel pipe. Circulated solution 7 hours; drained and then steamed out interiors to remove loosened asphalt.

RESULT: Oakite Composition No. 19 retained potent cleaning strength through entire procedure and easily cut through tenacious deposits. Removed all asphalt without damage to surfaces. Left clean surfaces to facilitate inspection and repair.

Your Cleaning Job Here?

(check it, clip and send to Oakite Products, Inc.)

- ☐ cleaning tank car interiors
- ☐ paintstripping equipment
- ☐ descaling water coolers
- ☐ steam cleaning equipment
- ☐ cleaning fractionating towers
- ☐ descaling debutanizer condensers
- ☐ cleaning heat exchangers
- ☐ cleaning gas coolers
- ☐ cleaning filters

look at these savings:

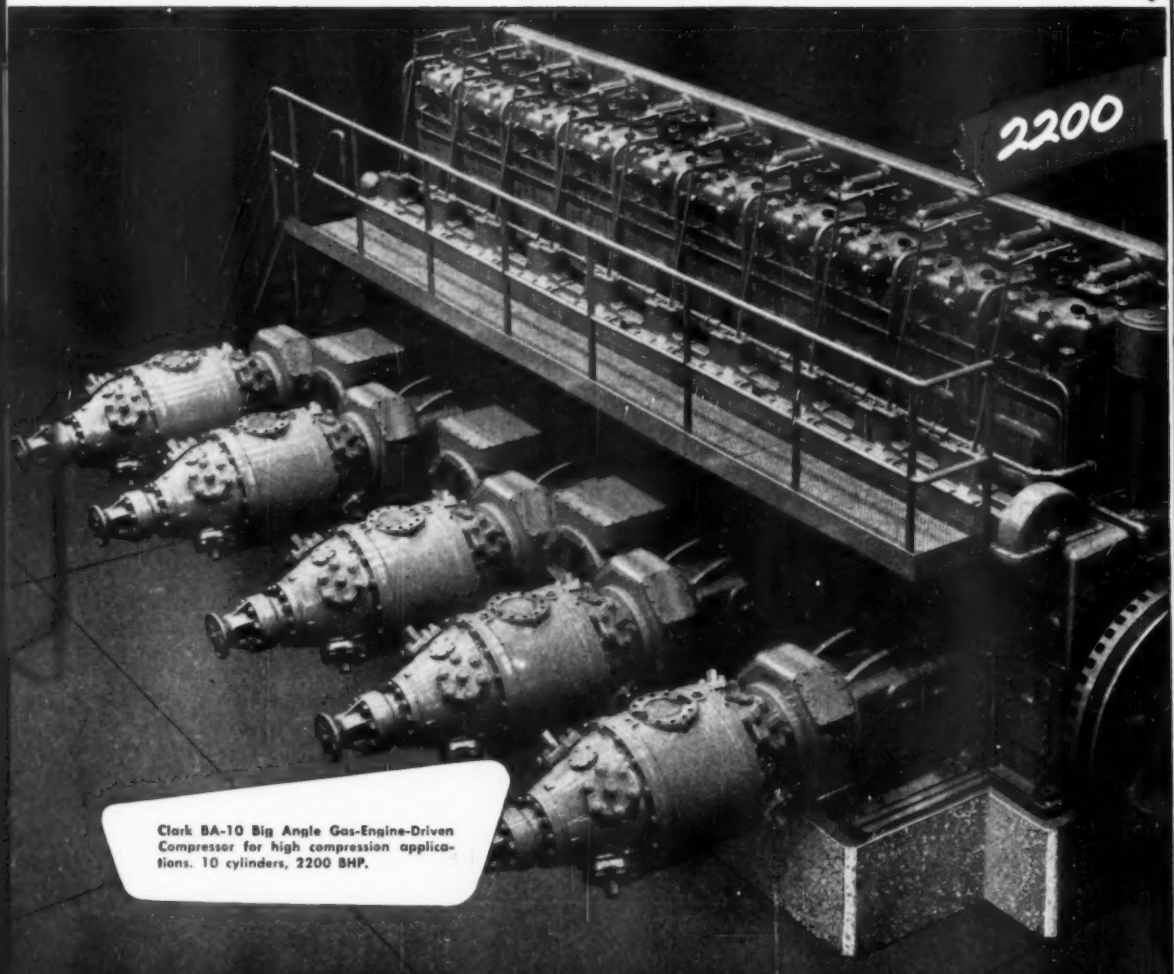
Former method took two men three to four days of hand chipping at a cost near $128. Specialized Oakite Composition No. 19 and Oakite Method cut that cost about half. And the job was completed in 10 hours.

Chances are Oakite cleaners and methods can solve your cleaning jobs, too. Contact your nearby Oakite Technical Service Representative next time a cleaning problem comes up. Or if you're stumped by one of the jobs at left, check it, clip and send to,

OAKITE PRODUCTS, INC., 41C Thames St., NEW YORK 6, N. Y.
Technical Service Representatives in Principal Cities of U. S. & Canada

When your pipeline operations call for

BIG COMPRESSORS



Clark BA-10 Big Angle Gas-Engine-Driven Compressor for high compression applications. 10 cylinders, 2200 BHP.

CLARK SETS THE PACE

ONE OF THE DRESSER INDUSTRIES

...CALL IN CLARK!

BHP GAS ENGINE DRIVEN

5500 BHP CENTRIFUGAL

the ONLY Company that builds BOTH!

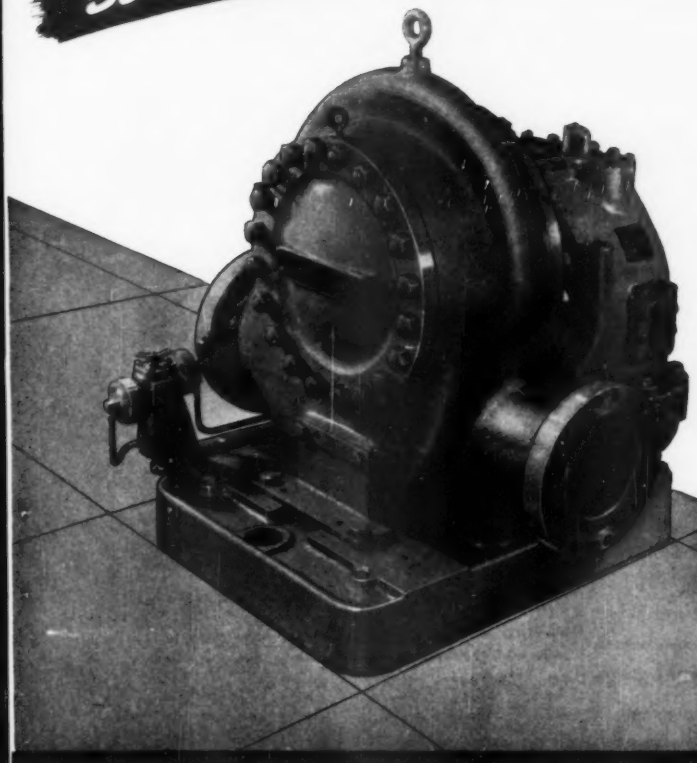
For large volume and high compression applications . . . call in the *one* company that builds *both* large Gas-Engine-Driven Compressors and Centrifugals.

Since we build both, we "have no axe to grind" in recommending the type best suited for your application. Each has its particular advantages . . . in first cost, operating cost, performance characteristics and installation requirements.

A Clark Bros. engineer will give you an unbiased analysis and recommendation on your large compressor needs . . . or any size compressor from 5 BHP up. Write or phone your nearest Clark Bros. office.

CLARK BROS. CO., INC. • OLEAN, N. Y.

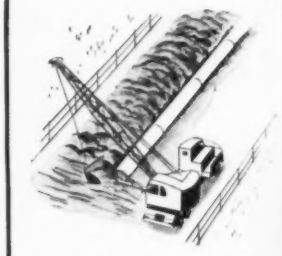
New York • Tulsa • Houston • Chicago • Boston
Washington • Los Angeles • London • Buenos Aires • Caracas, Venezuela.



Clark single stage, pedestal type, centrifugal pipeline compressor of which there are several installed on the Big and Little Inch pipelines.

IN COMPRESSOR PROGRESS

HOW TO *Stay* ON THE RIGHT-OF-WAY



How to Backfill on Right-of-way

This illustrates how the Lorain backfiller travels down one side of the trench—reaches across trench and backfills without leaving the right-of-way. Notice that the Lorain simply moves along the line—does not have to get behind the material or onto adjoining property to do the job.

• There's frequently little room to spare on the "right-of-way" of a pipe line job. The picture above shows how one contractor solved the problem . . . and avoided adjacent property damage and claims.

A Lorain dragline with special backfiller boom reached across the trench—never got off the right-of-way. Moving along the line, a mile of trench was backfilled per day.

Here is another example of the adaptability of Lorain equipment to all phases of oil field work. Whether it's a job at the refinery or in the field, there are dozens of jobs where a Lorain can pay profits.

One reason why—you can select from 160 Lorain combinations—in three series—on crawler or rubber—with 5 interchangeable front ends—to fit the job exactly, from start to finish. Get the Lorain story to fit your need now—from your nearest Thew-Lorain Distributor.

THE THEW SHOVEL CO., LORAIN, OHIO

HOW TO MAKE PIPE LINES *Pay...*

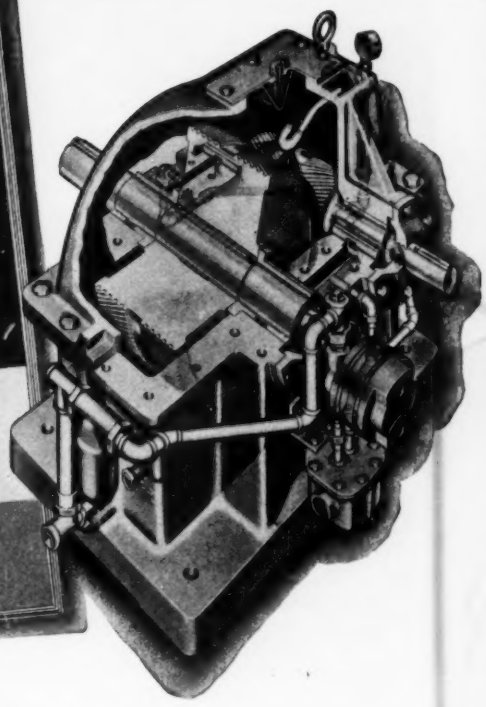
There's a Lorain for every pipe line duty. Here is a Lorain Hoe, one of 18 Lorains owned by Bechtel Corporation of San Francisco on a 210 mile loop of 31 inch pipe for Tennessee Gas Transmission Co.

MORE FOR YOUR $ IN A LORAIN

THEW · Lorain ® PIPE LINE BUILDERS

YOU CAN BE **SURE**.. IF IT'S

Westinghouse



HERE'S HELP

On High Speed Gear Problems ... Never Before Available

If you use speed increasing gear drives, you'll want a copy of this new book. It gives important information regarding recent developments in high speed gearing and extensive engineering data on lubrication, temperatures and efficiencies which you will find only in this book.

Write today for a copy of Booklet B-4281, or mail the coupon. Westinghouse Electric Corporation, Dept. 610, P. O. Box, 868, Pittsburgh 30, Pennsylvania. J-07285

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GEARED DRIVES

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Please send me a copy of your Booklet B-4281, "High Speed Industrial Gear Drives".

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Firm Name_____

Your Title_____

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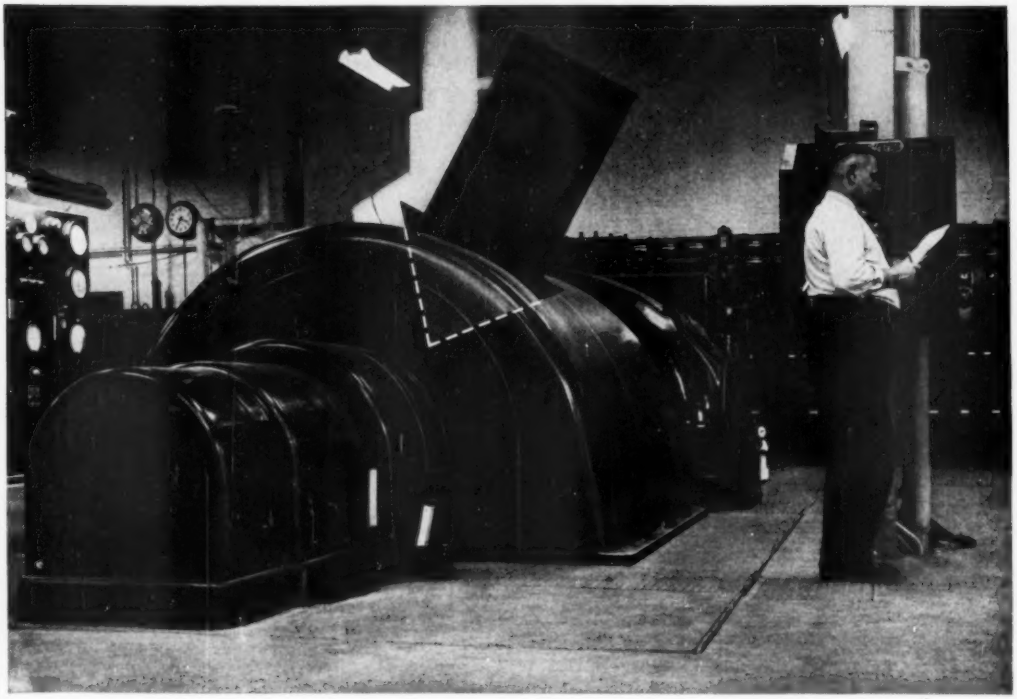
Under the skin of many a generator...



...*fire threats are smashed with* CO_2

Like thousands of other generators in power plants all over the world, these two units of The Ohio Box Board Company at Rittman, Ohio, are protected against the threat of fire by *Kidde** Built-in Systems.

If fire should start inside one of these generators, a heavy initial discharge of carbon dioxide (CO_2) from the *Kidde* System can extinguish any active flame within a few seconds. No danger that damage to the insulation will spread!

To prevent any possibility of a reflash, a continuing discharge of CO_2 maintains an inert, fire-suffocating atmosphere inside the generator during the run-down period.

Of course, there's no *extinguishing-agent* damage with a *Kidde* System. The CO_2 does not corrode metal or harm insulation.

Do *you* have a fire-protection problem? Whatever its nature, a Kidde representative will help you.

When you think of CO_2, call Kidde!

*Also known as "LUX"

The words "Kidde" and "Lux" and the Kidde seal are trade-marks of Walter Kidde & Company, Inc.

K Kidde

Kidde

Walter Kidde & Company, Inc. • 1054 Main Street, Belleville 9, N. J.

YOU'VE NEVER SEEN ROCK FLY SO FAST!

GARDNER-DENVER PIPELINER'S

Twindril

The Gardner-Denver Twindril consists of two heavy duty 4" drills, with easily controlled air motor driven feeds, clamped to a welded frame. The complete assembly hangs from the side boom of the tractor. Behind the tractor is hooked a Gardner-Denver WBK-500 Caterpillar Diesel powered portable air compressor connected to the two drills by air hoses.

Rock on the trench line? Get it out *faster than ever before* with the Gardner-Denver Model RMT Pipeliner's Twindril! Here's the fast-stepping unit that drills twin holes on each side of the trench—drills them to any required depth—then hurries ahead for the next pair. Your pipe line crews need no longer be slowed down by old-fashioned rock drill equipment! Adjustable for spacing drills from 2½ to 5 ft. apart.

Two Holes in 3 Minutes! It takes only 2½ to 3 minutes for the Twindril to drill a pair of holes in Middle Western limestone—and the move is made for the next pair of holes in ½ minute to a minute. Over-all time is 3 to 4 minutes for each pair of holes. You get a corresponding speed-up in harder rock formation. Six feet of hole can be drilled with no change of steel.

Completely Assembled-Ready for Work

The Gardner-Denver Twindril comes to you ready to hang on the side boom of your tractor and go to work as soon as it arrives on the job. It's completely assembled at the factory, with air connections in place. For service, the compressor and drills are backed by direct factory branches—there is one near you! Get all the facts about the Twindril—write today!

Gardner-Denver Company, Quincy, Illinois

GARDNER-DENVER SINCE 1859

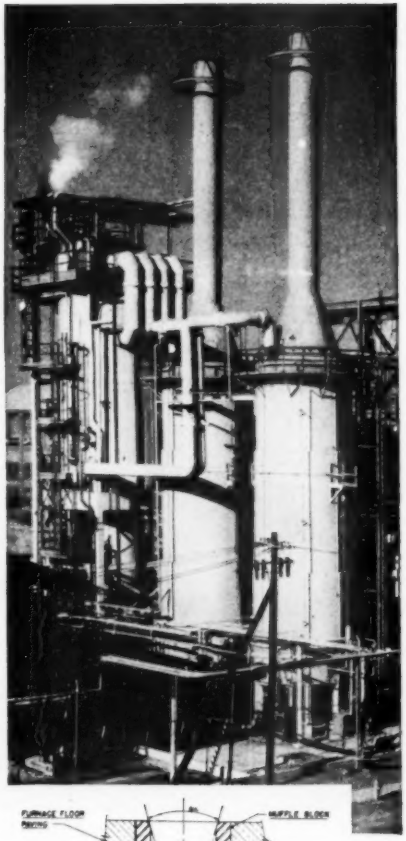
NATIONAL AIROIL Fuel Oil · Gas BURNERS

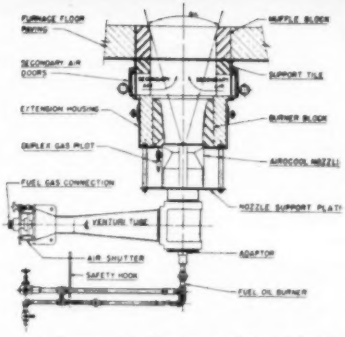
WIDELY USED THROUGHOUT INDUSTRY...

OIL-GAS TANDEM COMBUSTION UNITS

Yes, because of their extreme adaptability, "National Airoil" Vertical TANDEM COMBUSTION UNITS have been widely used throughout the petroleum industry. The TANDEM UNIT has a high turn-down ratio with a steady flame . . . maintains a high flame temperature with either fuel oil or gas; can be brought quickly to full capacity with a clean flame; and flame can be regulated and directed to uniformly radiate heat to the absorbing surfaces without impingement. The TANDEM COMBUSTION UNIT is also designed for firing horizontally, and for forced draft preheated air when necessary. It may also be applied to all types of boilers and process furnaces. Write for details about the TANDEM COMBUSTION UNIT and the various types available.

OIL BURNERS and GAS BURNERS for industrial power, process and heating purposes; STEAM ATOMIZING OIL BURNERS; MOTOR-DRIVEN ROTARY OIL BURNERS; MECHANICAL PRESSURE ATOMIZING OIL BURNERS; LOW AIR PRESSURE OIL BURNERS; GAS BURNERS; COMBINATION GAS and OIL BURNERS; AUTOMATIC OIL BURNERS, for small process furnaces and heating plants; FUEL OIL HEATERS; FUEL OIL PUMPING and HEATING UNITS; FURNACE RELIEF DOORS; AIR INTAKE DOORS; OBSERVATION PORTS; SPECIAL REFRACTORY SHAPES.





This diagrammatic drawing is of the National Airoil OIL-GAS TANDEM COMBUSTION UNIT (firing vertically upward) . . . widely used and popular in oil refineries throughout the nation.

NATIONAL AIROIL BURNER CO., INC.

Main Offices & Factory: **1236 EAST SEDGLEY AVENUE, PHILADELPHIA 34, PA.**
Texas Office: 2512 South Boulevard, Houston 6

INDUSTRIAL OIL BURNERS, GAS BURNERS, FURNACE EQUIPMENT

Brute Strength *and a "Delicate Touch"*

An **OLIVER** "Cletrac" **Plus Advantage**

Oliver "Cletrac" Model FDE equipped with shear dozer and tree pusher mounted on Drott Trailbuilder clearing right-of-way.

Clearing a right-of-way for power lines is a job that requires an ideal combination of brute strength and perfect control. The answer . . . Oliver "Cletrac"!

This model FDE equipped with a shear dozer and tree pusher mounted on a Drott Trailbuilder is the ideal unit for land clearing and grubbing. It removes only the minimum amount of top soil . . . yet it effectively clears the right-of-way.

The husky Oliver "Cletrac" Model FDE provides plenty of rugged power for the toughest terrain. And the new Oliver "Cletrac" air steering and braking system provides the perfect control so necessary for fast, efficient operation, *on level ground or steep slopes.* Add to this, the fact that there is always power on both tracks . . . *even on turns* . . . and it's easy to see why the Oliver "Cletrac" combination of brute strength plus the light touch on the controls is the ideal unit for any job.

For all the facts, see your Oliver Industrial Distributor or write to The Oliver Corporation, Industrial Division, 19300 Euclid Avenue, Cleveland 17, Ohio.

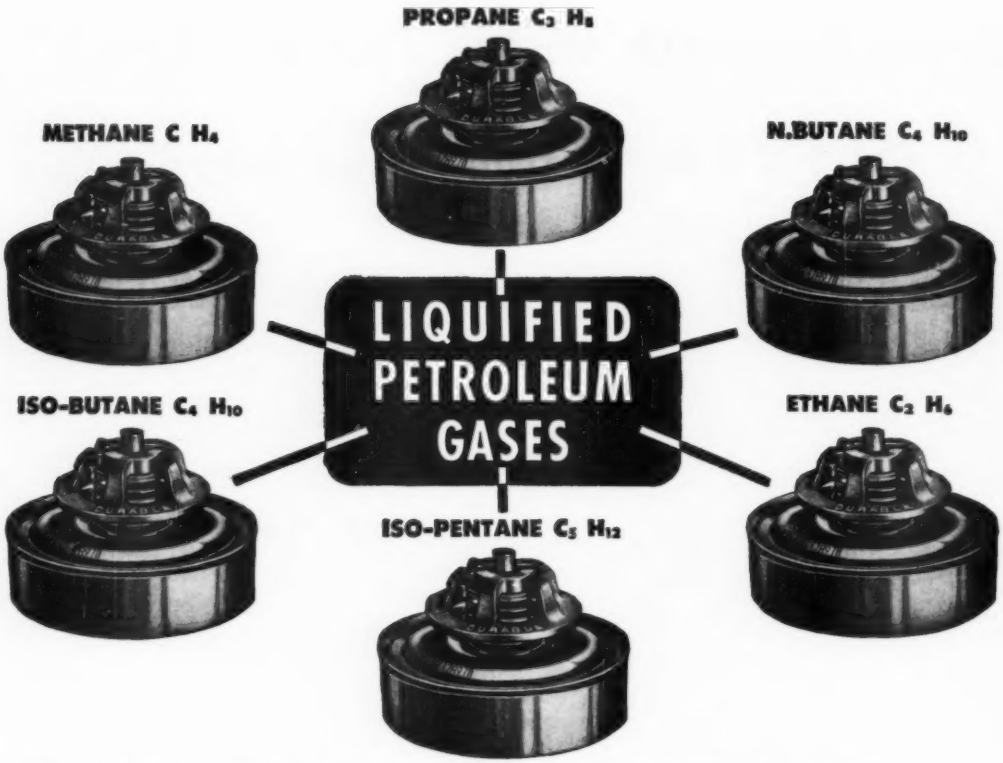
Cletrac

a product of

The **OLIVER** Corporation

A complete line of Crawler and Industrial Wheel Tractors

"THE SIGN OF EXTRA SERVICE"



DURABLA PUMP VALVES FOR LIGHT HYDROCARBONS

When close clearance or any other design of reciprocating pumps are used for handling the greatly increased production of light hydrocarbons, DURABLA METAL PUMP VALVE UNITS* are your guarantee of high performance, freedom from "gassing" and replacement problems. The arched and curved shape of the valve member absolutely minimizes "slip", cavitation, and turbulence. DURABLA Valves are precision engineered, especially for this service.

Pump valves all open with a tilt action towards the flow line or line of least resistance. DURABLA Valves, being free-tilting, follow this natural law, which is not possible with high hub stem-guided valves or wing guided valves where large side friction is caused when they attempt to tilt in accordance with this basic law . . . and no other free tilting valve is as light as the DURABLA Valve.

ONLY DURABLA OFFER ALL THESE ESSENTIAL FEATURES FOR LIGHT HYDROCARBON SERVICE

- Feather Weight Valve Member
- Free-Tilting Valve Member Without Side Friction
- Snap Action Under Any Load
- Positive Seal Independent of Contraction and Expansion of Gases
- Does Not Need Lubrication
- Compact Design, Stocked in 11 Standard Sizes to Fit Any Pump

Write DURABLA Engineering Department for information and Bulletin, Reference 9G10

*Patent Numbers 2090486, 2117504

DURABLA MANUFACTURING COMPANY
114 LIBERTY ST. NEW YORK
BRANCHES IN PRINCIPAL CITIES. FOR CANADA REFER: CANADIAN DURABLA LIMITED, TORONTO

REPUBLIC ELECTRIC WELD LINE PIPE

Leads the field by 10 good points

Here's the score—during the past 20 years, more than 51,000 miles of Republic Electric Weld Line Pipe have been installed in oil, gasoline, natural gas and by-products lines. And, here are the 10 basic reasons for its popularity—the reasons why this modern pipe goes in the ditch fast and gives trouble-free performance throughout its long life.

1. **Uniform Roundness**—Pipe ends match up perfectly—speed construction—cut costs.
2. **Uniform Diameter**—No "off-size" lengths to cause welding difficulties at joints.
3. **Uniform Wall Thickness**—Absolute dependability throughout every inch of length and circumference.
4. **Uniform High Yield Strength**—Permits building of higher pressure lines—utilizing design values to fullest advantage.
5. **Uniformly Straight**—Lengths line up evenly—go into the ditch freely.
6. **Easy to Bend**—High-ductility steel makes bending in the field easy.
7. **Easy to Weld**—Low carbon steel welds readily—makes sound joints.
8. **Freedom from Scale**—Insures against clogged valves, contamination of petroleum products.
9. **Long Lengths**—Reduces number of joints—makes jobs move with longer strides.
10. **Inspected Inside and Out**—Republic Electric Weld Line Pipe is made from flat-rolled steel both sides of which are closely inspected. Thus, you are assured that the surface which becomes the inside wall when formed into pipe is free from hidden defects.

Write for literature.

REPUBLIC STEEL CORPORATION
GENERAL OFFICES • CLEVELAND 1, OHIO
Export Dept.: Chrysler Bldg., New York 17, N.Y.

Republic
REPUBLIC STEEL
ELECTRIC WELD LINE PIPE

Other Republic Products Include Casing and Tubing—Carbon, Alloy and Stainless Steels—Studs, Bolts and Nuts—Heat Exchanger Tubes

Here's 1 Controller that holds 2 related variables within set limits

The NEW FOXBORO M-40 AUTO-SELECTOR

This Unique Controller operates from two related measurements, automatically transferring control from one to another as required to prevent either one from exceeding its set limit. As in the case diagramed at right, when supply is greater than demand, control is maintained on the demand side (discharge) . . . but when demand exceeds supply control is maintained on the supply side (suction).

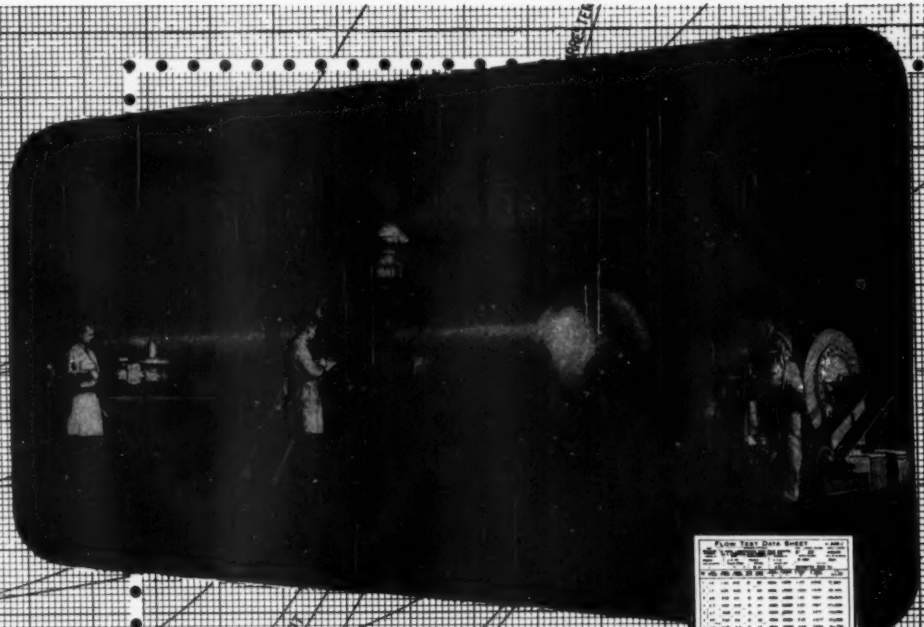
The M-40 Auto-Selector has two measuring elements and control mechanisms — also a combined air relay. It actually does the work of two instruments . . . with one or the other variable under control at all times. The transfer of control from one variable to the other is smooth, instantaneous, and with no upset. Any type of control action may be used. Any combination of related variables may be controlled - pressure and flow; temperature and level; two flows; two pressures; etc.

DIAGRAM *with accompanying chart above illustrates one of many applications. Pump drive is controlled to keep suction pressure from dropping below a set minimum, and discharge pressure from exceeding a set maximum. The instrument automatically controls from either variable as changing conditions require. On the chart, the outer record is for discharge pressure, the inner, for suction pressure.*

Write for details. The Foxboro Company, 60 Neponset Ave., Foxboro, Mass., U. S. A.

FOXBORO
REG. U. S. PAT. OFF.

RECORDING · CONTROLLING · INDICATING
INSTRUMENTS



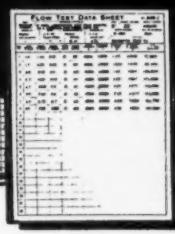


Figure No. 58-A, "VAREC" Conservation Vent Unit.

LABORATORY ASSURANCE . . .
FIELD INSURANCE . . . .

Optimum tank protection means selecting venting equipment which has adequate flow capacity to meet all your tank venting requirements. You can compute these requirements on the basis of the "VAREC" formula as described in the "VAREC" P-7 Handbook and Catalog or you can use any other acceptable tank venting standard. Adequate flow capacity, however, should be determined by actual test.

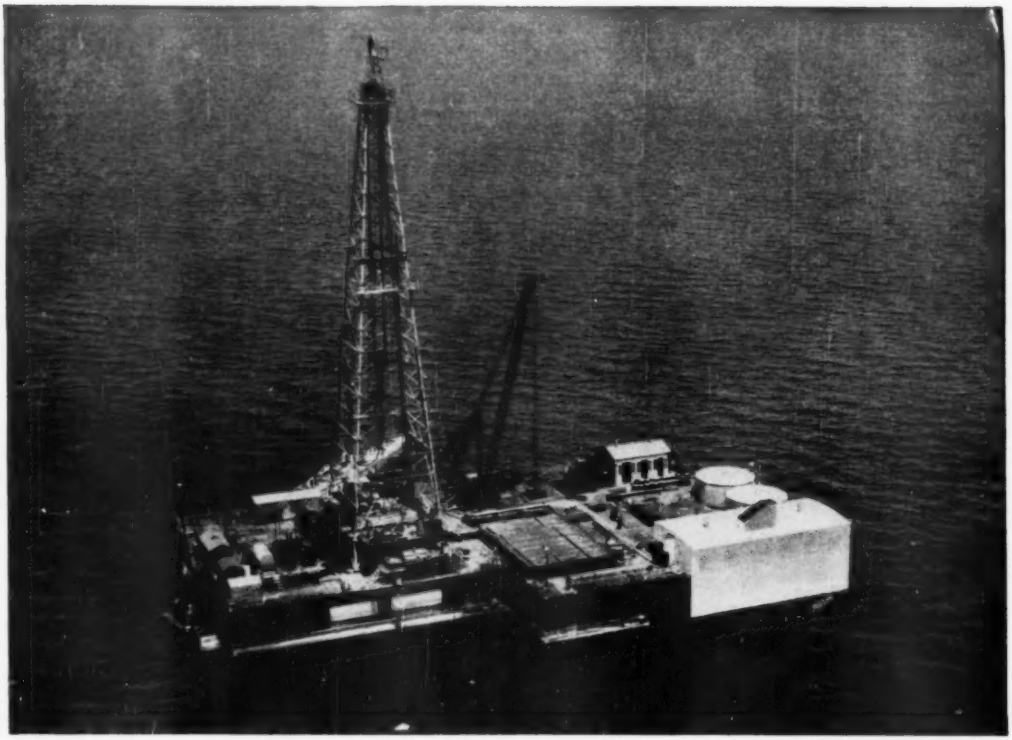
The Vapor Recovery Systems Company continuously makes such tests in their modern flow test laboratory. Flow curves for all "VAREC" Vent Valves, Flame Arresters and Vent Units are modified as design improvements are made. These flow curves accurately indicate the minimum size that will meet your venting requirements. The latest curves are available upon request. The "VAREC" flow testing apparatus and laboratory also are at your service for any special flow problems. Write today.

P-9

PROVED and APPROVED "Varec"

THE VAPOR RECOVERY SYSTEMS COMPANY
COMPTON, CALIFORNIA, U.S.A.

NEW YORK 30 CHURCH ST. PITTSBURGH 939 GULF BLDG. CHICAGO 122 SO. MICHIGAN AVE.
TULSA 409 TULOMA BLDG. HOUSTON 821A M. & M. BLDG.
CABLE ADDRESS: VAREC COMPTON (ALL CODES)



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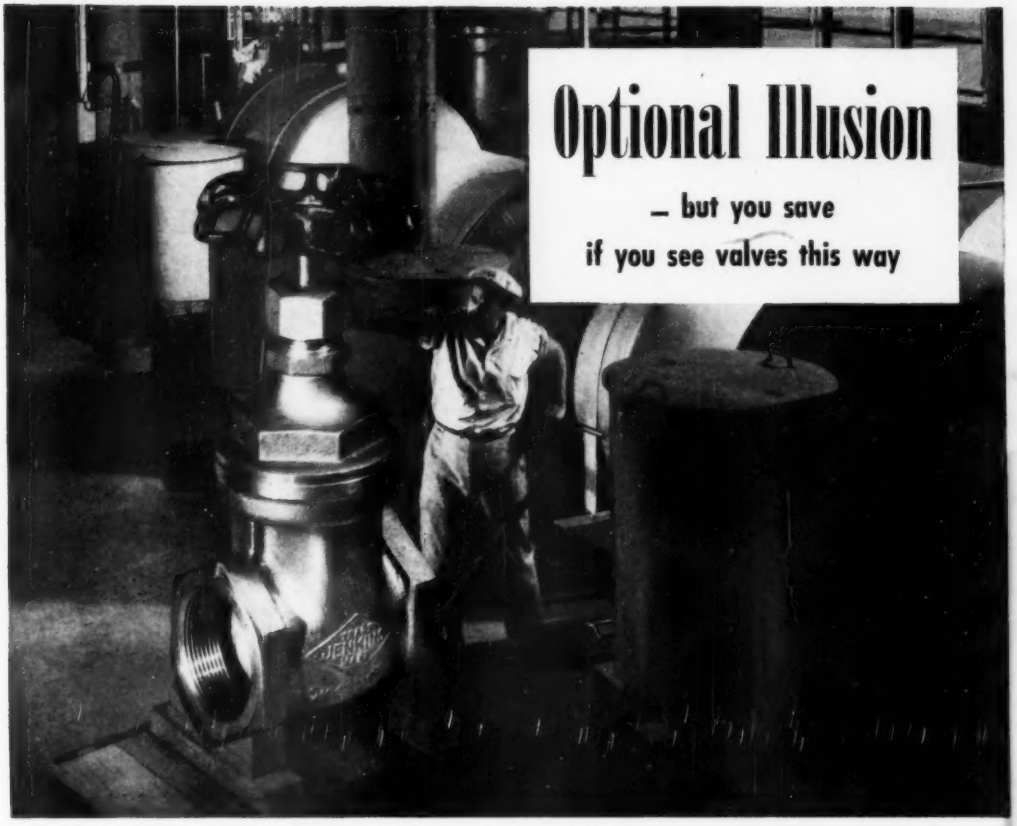

Optional Illusion

— but you save if you see valves this way

THERE ARE TWO WAYS of regarding the valves in any plant. You can think of the relatively small cost of a single valve, and dismiss it as a minor, "petty cash" investment. Or, you can think of *all* valves in your plant as *one* valve, as pictured, by photo-magic, in this pharmaceutical plant,—and see valves in proper perspective.

YOU'LL FIND IT PAYS to take the latter view, for in *any* plant, *any* building where fluid control is involved, valves, collectively, are as important, in terms of investment and operating expense, as larger plant units, and should be selected with the same sharp eye to quality and economy.

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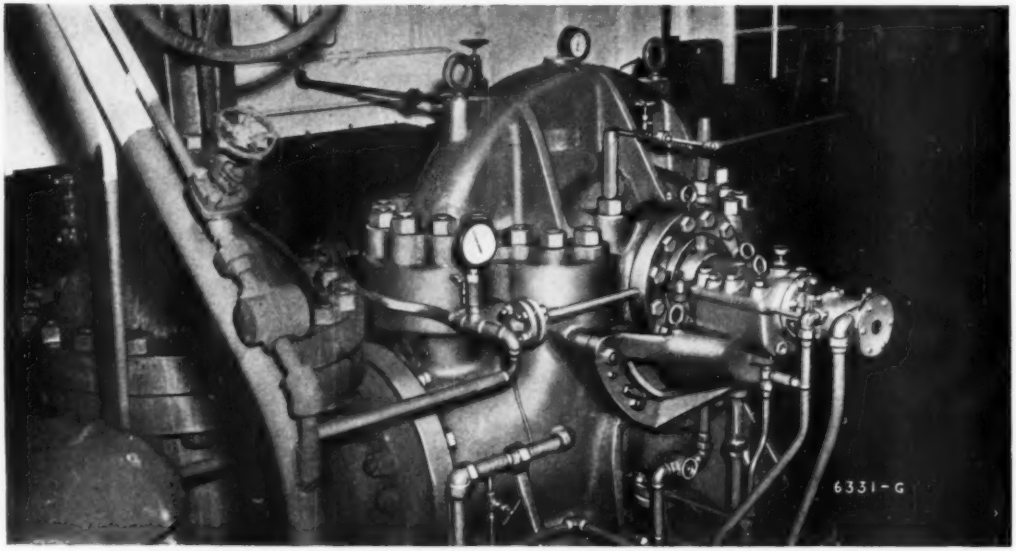

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They Say—

Decline of Geology

Sir:

In the July 1942 A.A.P.G. is a paper by Carey Croneis (now president, Beloit College), titled, "Geology in War and Peace," an indictment of the past and present status of geology as a profession. I suggest a reading (or re-reading).

Your comments (*"What Lies Over the Horizon?" The Oil and Gas Journal, September 22, page 315)* show that geophysics, geochemistry, and petroleum engineering are leading the field of petroleum technology, and show an absence of geologic research of similar type.

The reason is obvious: geologists rarely approach the laboratory; geophysicists, geochemists, and geoengineers always are active in the laboratory.

Geology has been too much a "medieval" science: too much imagination—too much speculation. Not enough precise work with mechanics of structures, for example, or enough work with experimental work in sedimentation—too few, if any, geologists are connected with marine laboratories trying to solve recent shoreline processes.

In short, geologists are by far too much in the rear of the procession that is discovering the elements of earth science.

Geologists such as Paul Weaver, M. King Hubbert, Theodore A. Link, L. L. Nettleton, William C. Krumbein, Sylvain J. Pirson, and others are doing something in earth science, but note that Weaver, Hubbert, Nettleton are better known in the field of geophysics. Men like E. E. Rosaire and Pirson are better known in geochemistry. Too few geologists, **per se**, are making the real contributions.

Maury M. Travis,
Geologist, Denver.

Fight for Business

"As far as the oil business is concerned, I know that each of us is competing in a field where there are thousands of different oil companies serving the United States. If one of these companies can build a better product, sell it at a lower cost, or give better and cheaper service, it will soon take business away from its competitors.

"This spirit of competition is resulting in the rapid growth of the business, more and better petroleum products, distribution of these products to the places where consumers want them, and in the proper quantities, at the right time, at lower costs.

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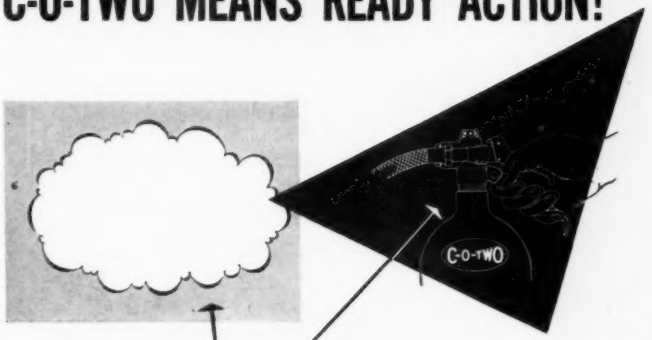

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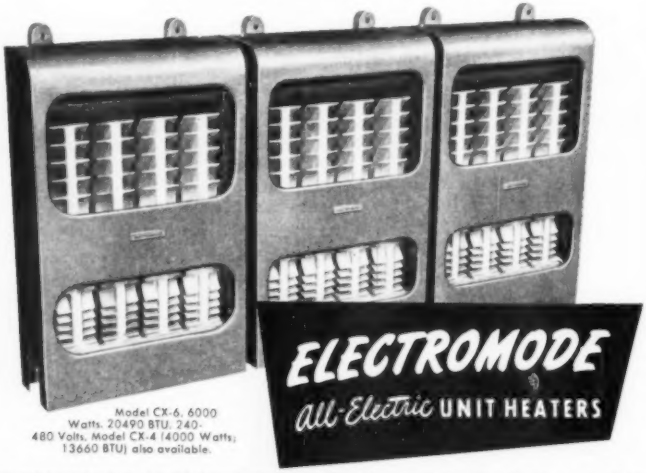

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Oil's Greatest Salesman

"John L. Lewis, United Mine Workers' president, who is no shrinking violet in applying uncomplimentary labels to his adversaries, has acquired one of his own: 'The greatest salesman the oil and gas industries ever had.' . . .

"Gas in recent years has become the cheapest means of heating many Chicago area homes, and economics

Some Day He May Go Too Far

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is the sole governing factor in the choice of gas for many commercial and industrial operations. Oil is cheaper than it was a year ago, and coal more expensive. Assurance of a steady supply is the other principal factor in swinging coal consumers to oil or gas." *The Chicago Tribune.*

Getting in Step

"Late last year The Oil and Gas Journal started compilation of world oil production; it was a difficult and expensive task, but month by month the service has improved. Wednesday the Journal released its survey covering the month of July.

"Tuesday, the Bureau of Mines announced a new monthly survey report. You guessed it; world oil production. First issue covered the month of February. (The Oil and Gas Journal reported February production at

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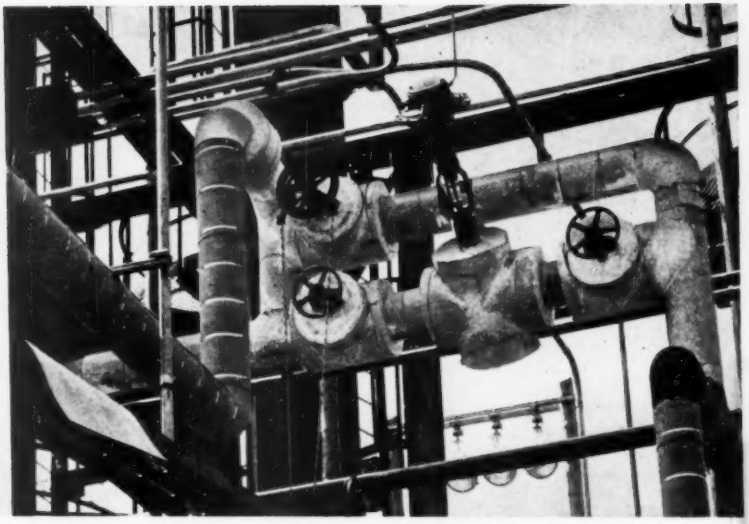

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9,445,000 bbl. daily, while the bureau reported it at 9,410,000 bbl.) *Claude V. Barrow's column, "The Slush Pit," in The Daily Oklahoman.*

Co-op Taxes

"Undoubtedly the next tax bill must deal with the tax-exempt corporations, including cooperatives. However, I do not think any headway can be made with an amendment of HR 3905, a bill which cannot be reached in the Senate before January. It is not possible to write a suitable provision on tax-exempt corporations on the floor of the Senate. However, at the January session of Congress I have no doubt we will be able to go into this question fully." *Sen. Walter F. George, chairman of the Senate finance committee.*

Imports from Canada

"Canada has found it necessary to take some measures to conserve her dollar reserves. I am hopeful, however, that we may work out ways and means to bring our trade into better balance. Some of the oil in Alberta will undoubtedly find markets in our northern states, and thus bring more American dollars to Canada. It is also possible that natural gas in the Alberta fields will be plentiful enough so that it can be piped and sold to our own fuel-short West Coast states. As our own iron ore is depleted, and the tremendous deposits in Quebec and Labrador are developed, Canada will have another new source of dollars. By such means and as a result of the further development of Canadian resources that are needed in the United States, I am confident that together we can find ways to overcome the dollar problem as between our two countries." *Secretary of Commerce Charles Sawyer, address before Victoria, B. C., Chamber of Commerce.*

Welfare State

Oil pioneers overcame public ridicule, physical hardship, and their own repeated misgivings. They persisted against great odds. Would they have had such initiative or such incentive in a planned system that concerned itself primarily with personal security and physical comfort? *The Tribune-Republican, Meadville, Pa.*

Arabian Project

"Building a foreign job in a wide, empty space where there are no convenient public utilities and other agencies already set up to serve you is a job requiring broad vision and great courage on the part of the companies that pay the bills—the progressive, far-sighted American oil companies." *Bechtel Briefs, Bechtel Corp.*

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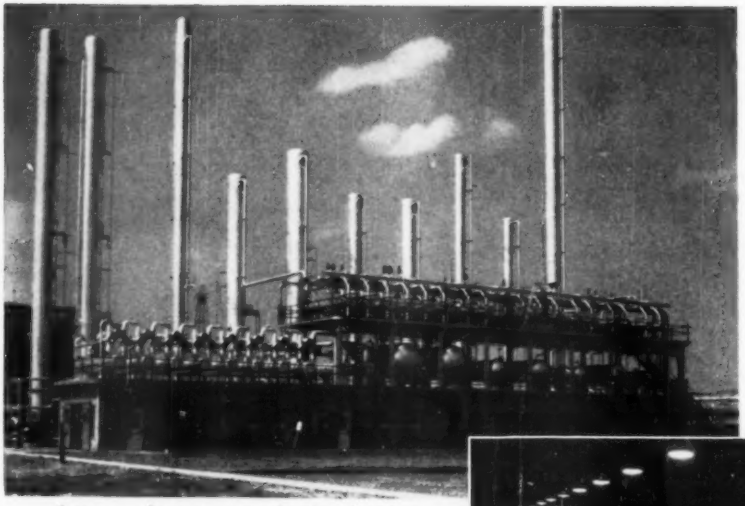

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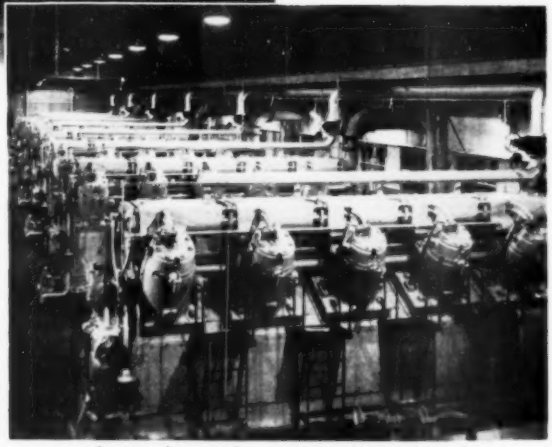

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JOURNALLY Speaking

Pipe Course

IT'S not exactly what we meant by the term when we were choosing our curriculum in college, but there's a pipe course in this issue.

It's primarily for pipe liners and is really a seminar conducted by a score of "professors," each an expert in some phase of the pipe-line art—or should we say science? They tell just about everything that's new and useful in the industry from mathematical formulas to digging ditches, and there isn't a pipe liner in the business who can't pick up an idea or two here.

But just because you're not an engineer, don't get scared away by those articles full of graphs and equations. There's a lot of dope for executives to think about, and for the casual education of those in other branches of the business.

And if you can't read you can look at the pictures, and this pipe course opens with a slew of them which at least should dissipate any idea that it's a pipe to be a pipe liner.

Pipe Dreams

THAT pipe liners have plenty of imagination is shown by several pieces in this issue.

Note particularly "Predictions" by the redoubtable "Cap" Finney, spiritual granddaddy of all pipe liners, who sticks his neck out to forecast what's going to happen in the business a few years from now. Even today's most efficient pipe line, he says, is a challenge to improvement, and there are so many ways of doing things better that predictions are easy. Pipe material that won't rust or corrode, some kind of goo that will keep the inside of a line smooth and shiny, pump stations that operate untouched by human hands—such are the stuff of Cap's pipe dreams.

Then our own Pipe-Line Editor, while cautiously shying away from the realm of fantasy and keeping his feet firmly planted in the ditch, reports on novel experiments "on the line" which point toward cheaper and more efficient construction methods. Which just goes to show that the slip-stick engineers don't know all the answers and the boys behind the welding rods and bulldozers have a trick or two up their sleeves also.

A story of a pipe dream which came true is Bob Bullock's report on how he stops pipe-line leaks before they start. He found out where leaks were most apt to occur and then studded those sections so thick with magnesium anodes that the line replated itself as fast as it could corrode away. Sounds simple the way he tells it, but we have it on good authority that it's well nigh a revolutionary stunt.

Pipe Down

ONE pipe liner who won't pipe down on his pet peeve is Benjamin Miller. His peeve is that engineers are too cautious in designing new pipe lines. Claims they figure out how strong the pipe ought to be and then add some extra thickness just to play safe or make sure they didn't figure too close. Might as well dig a big hole in the ground and pour the steel in direct from the mill, Ben says.

This department helped him along last January by printing a letter in which he took some cracks at his steel-wasting colleagues and called them the "last to get up to date." We thought maybe some of the boys would get sore and pipe up to defend themselves or else that Ben, failing to get a nice, lusty fight, would pipe down and forget it. But he didn't. In this issue he comes back with both fists and a lot of fancy-looking formulas to prove his point.

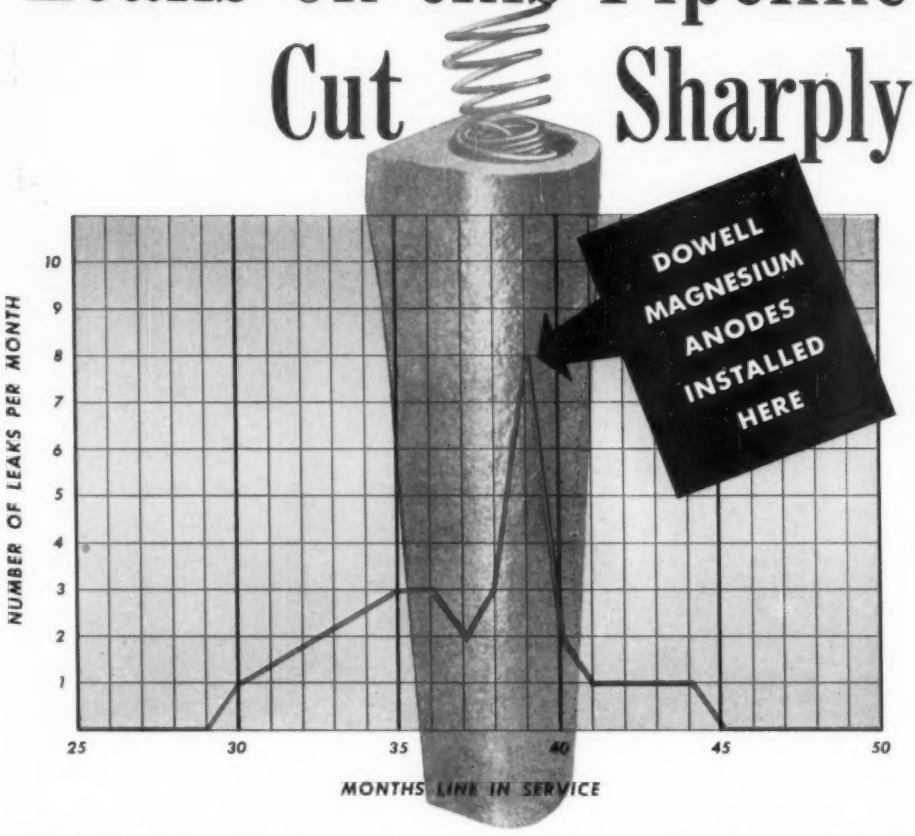
Anyone interested in saving 10,000 tons of steel on a 600-mile pipe line can learn how to do it from Brother Miller.

Pipe This

AND if you don't want to read a doggone word about pipe lines you can snatch out the map that's folded into this copy. Even if you don't care where all the natural-gas lines in the country run, its gorgeous green will lend a spot of color to your drab office wall.

—*Henry D. Ralph*

Leaks on this Pipeline Cut Sharply



The graph above shows the dramatic reduction in leak rate that occurred when Dowell magnesium anodes were installed on a 33 mile 8 inch asphalt covered pipe line. This installation saved thousands of dollars in maintenance costs alone, as well as extending indefinitely the time when the line would have to be reconditioned or replaced.

This is an example of the savings that can result when Dowell anodes are used to control corrosion on underground pipelines. The degree of protection afforded will depend upon soil conditions encountered and the number of anodes used. Easily and economically installed on existing pipe lines, Dowell magnesium anodes require no external power and cut maintenance costs to a minimum. Also, Dowell anodes are alloyed to specifications designed for maximum anode efficiency and long life.

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THE OIL AND GAS JOURNAL

A Transportation Industry

THE pipe-line movement of petroleum and natural gas is rapidly becoming a dominant transportation phase of this country's entire economy. There is plenty of proof currently to support this statement, coming in part from other methods of transportation which are finding it increasingly difficult to compete with the pipe-line arteries.

As of today the pipe lines are transporting in excess of 5 million barrels of crude oil and other petroleum liquids; about 1 million barrels of gasoline, kerosine, and distillate; and 9 billion cubic feet of natural gas. The gas figure is confined to public-utility sales and does not take into consideration gas consumed in the fields, including carbon-black plants.

The magnitude of this transportation operation can best be visualized by reducing it to a common denominator. The pipe-line movement of crude oil and products of 850,000 tons daily compares with the petroleum shipments of Class 1 railroads now totaling about 180,000 tons daily.

The tonnage of the product lines, the first major system of which started operating less than 20 years ago, is rapidly catching up with the petroleum shipments of all the railroads. As freight rates climb, the spread in costs in favor of the pipe lines continues to widen. It is certain that these product lines, now totaling about 20,000 miles, will be extended to smaller markets which the original sponsors never expected to touch.

As regards natural gas, observers of developments in our national economy are again pointing out that the head of the coal miners' union is the "best salesman that oil and natural gas have"! In coal equivalents, shipments of crude oil, products, and natural gas total about 1,700,000 tons daily, which compares with the total output of all coal, previous to the strike, of approximately 1,800,000 tons daily. The gap between the two is closing rapidly.

Important fuel-consuming centers, remote from the oil and gas fields, are now largely independent of coal supplies and they will be joined by others as major construction programs are completed over the next 2 years. Oil and natural gas are in fact the only effective protection the nation has in the steady march of higher delivered prices for coal, brought about by policies of both the railroads and the coal industry.

Continued growth is assured so long as both crude oil and product lines are integral parts of the petroleum industry, and the production, transmission, and distribution of natural gas are not circumscribed with laws and bureaucratic interpretations which serve neither the operator nor the consumer. Accomplishments up to now have been possible only because competition and the application of conservation practices in the oil and gas industry have stressed the need for the lowest possible transportation charges between the well heads and tens of millions of consumers.

Imports, Foreign Oil Aid Draw Fire Of Independents in Annual Meeting

by Charles J. Deegan

FORT WORTH.—A report that imports of foreign oil are now displacing about 700,000 bbl. per day of domestic production which could be made available to meet current demands, and charges that government aid to foreign oil development under the European Recovery Program constitutes a threat of national suicide marked the twentieth annual meeting of the Independent Petroleum Association of America here October 2-4.

The more than 1,000 independent producers attending the meeting obviously regarded the statement on imports of the supply and demand committee as statistical confirmation of their belief that imports are excessive and are depriving them of a part of the United States market to which they are entitled.

Walter S. Hallanan, president of Plymouth Oil Co. and chairman of the National Petroleum Council, seemed to strike the keynote of the general sentiment in his address at the opening session.

After recounting the high spots of the 20-year history of the organization, he said: "It is passing strange, and not without significance, that the same major problems that existed when your association was organized are upon our doorstep at this moment. The independent oil man has met and solved these problems before, and he will lick them again. We have learned that in our modern fluid and volatile economy, eternal work and vigilance are the price of selfpreservation. We have been made to realize that we cannot achieve a goal and then rest complacently upon our oars. We cannot drift with the tide."

European Aid Denounced

Referring to portions of the European Recovery Plan, Hallanan denounced the proposed use of American tax dollars to finance European oil production and refining facilities —which are capturing American export markets—as nothing more nor less than a form of national suicide.

"We are creating a Frankenstein monster that will seriously cripple the effectiveness of the domestic oil industry, and to the same extent and in the same degree the national security will be impaired," Hallanan said. "We must recognize that we are in an era of expanding world production and contracting markets, but the American producer has a right to expect that the American market will be protected against ruinous and unfair competition from abroad, especially from those sources that are financed by American generosity. As a matter of national security, the American people have a right to expect it."

Robert L. Wood, Midland, I.P.A.A. membership chairman, presents Outgoing President Fred W. Shield with a scroll bearing the names of 1,200 new members, all recruited during Shield's term. The presentation, acknowledging Shield's work as president, was made during the annual banquet October 3 and was a result of Wood's "Fred Shield Appreciation Drive" for new members

Many members commented on the close proportion between the figures given by Hallanan on the production-import situation 20 years ago that lead to the founding of I.P.A.A., and the estimates of the supply and demand committee for the fourth quarter of 1949. In 1929 the figures were 2,743,000 bbl. daily domestic crude production and imports of 323,000 bbl. daily. The supply and demand committee figure for domestic crude available is 5,840,000 bbl., plus 460,000 bbl. of natural gas liquids (which were of minor importance 20 years ago) compared to imports of 700,000 bbl. daily.

Noting that domestic available supply was now 700,000 bbl. daily in excess of market demand, Russell B. Brown, general counsel of I.P.A.A., reminded the members that 1 year ago the National Security Resources Board, or its staff, prepared an "unofficial" and "confidential" report suggesting that an emergency reserve productive capacity of 1,000,000 bbl. daily be created in the United States by increasing imports and restricting production. Brown said: "I have long regarded that report as a formal invitation to the importing companies to do their part to create a reserve producing capacity in this country. It is bureau philosophy usually to hoard, not to create and expand."

Expansion Plans Cited

As to the future, Brown citied further government-agency plans that seem to threaten the welfare of the independent producer. He referred to a document released last week by the Economic Cooperation Administration containing a statistical summary of the plans for the expansion of world oil production, compiled from individual oil-company programs and from other sources by representatives of the British and Dutch governments and of ECA. *(See story on page 152 of this issue).*

Brown said "The programs thus outlined are for continued expansion of production and refining abroad. For some reason unknown to me the survey gives the figures for 1948 actual, and for 1952 and 1953. Whatever the plans for 1950 and 1951 may be the report does not show but we may be sure the American, British, and Dutch combination abroad have not left the next 2 years unplanned."

Brown also said that at the insistence of the Texas congressional delegation, the State Department had inquired into the intentions of the importing groups, and that the unannounced but quite generally "leaked" result is an estimate of 730,000 bbl. per day for the fourth quarter, an increase of 125,000 bbl. daily over the third quarter.

Warren Named President

J. E. Warren was elected as the new president of I.P.A.A., replacing Fred Shield, who retired. All other officers were reelected for another term, as follows: Harold B. Fell, executive vice president; D. R. Snow, treasurer; Russell B. Brown, general counsel, and C. E. Buchner, executive manager. Warren is president of Carl B. King Drilling Co., and a partner in King, Warren & Dye, independent producers, Midland, Tex.

Six new members were elected for

3-year terms on the executive committee: Clyde H. Alexander, Dallas; J. P. Coleman, Wichita Falls; Noble C. Ginther, Houston; Lawrence Vander Leck, Los Angeles; Robert L. Wood, Midland, and C. H. Lyons, Shreveport.

New vice presidents elected included Hugh M. Allen, Anchor Oil Co., Maricopa, Calif.; Guy White, Delta Drilling Co., Evansville, Ind; J. W. Kounce, Jones - O'Brien, Inc., Shreveport; Merle Becker, W. C. McBride, Inc., St. Louis; M. R. Wagner, independent, Cut Bank, Mont.; T. H. Marshall, Anderson - Prichard Oil Corp., Oklahoma City; F. Wayne Fesenmyer, Minard Run Oil Co., Bradford, Pa.; Frank Jacobson, Buffalo Oil Co., Dallas; V. C. Perini, Jr., independent, Abilene; Paul L. Davis, independent, Midland; and Frank Lefevre, Al Buchanan Drilling Co., San Antonio.

I. E. WARREN

Stripper Officers Elected

The National Stripper Well Association also elected officers at this meeting, the new slate consisting of J. P. Jones, Bradford, Pa., president; V. C. Perini, Abilene, Tex., first vice president; M. C. Powers, Huntington, W. Va., second vice president; G. G. Bauer, Bradford, executive secretary. Jones is also director of production of Pennsylvania Grade Crude Oil Association; Perini is president of West Central Texas Oil and Gas Association; Powers is an independent producer; Bauer is also executive secretary, Bradford district of the Pennsylvania Grade Crude Oil Association.

At the annual dinner, Marriner S. Eccles, member of the board of governors of the U. S. Federal Reserve System, gave an informal discussion of the current world financial situation.

This was followed by a twentieth anniverasry tribute to the past presidents of the I.P.A.A. and the founders of the organization who were present at the first meeting in Colorado Springs in 1929. The past presidents: 1929-1935 Wirt Franklin; 1935-1939 Charles F. Roeser; 1939-1943 Frank Buttram; 1943-1945 Ralph T. Zook; 1945-1947 B. A. Hardey; and 1947-1948 Merle Becker. Wirt Franklin, first president, made the response.

In a Tuesday morning session I.P.A.A. members were told by William L. Horner, chief engineer of Barnsdall Oil Co., that the independents have led the way in developing water - injection pressure - maintenance projects to increase oil recovery.

In 1943, he said, there was only one such project, whereas a recent survey showed more than 20, with many more known to be in the planning stage. Horner cited four fields in Arkansas and Louisiana where water or water and gas injection will result in an increase in recovery to 101 million barrels as compared with 42.6 million barrels estimated recovery without such work.

Membership Gain Reported

In his annual message, President Fred Shield reported a gain of 1,000 members during the year, bringing total membership of the association to 8,000. He reviewed accomplishments of the association achieved by the participation of members, particularly actions which prevented unfavorable conditions from arising.

Tuesday morning the association adopted the following five resolutions:

1. Denouncing the "flood" of imported oil, asserting only congressional action can provide an effective curb.

2. Opposing the use of tax money for petroleum projects under the Economic Cooperation Administration beyond the minimum requirement contemplated in the basic objectives of economic recovery and political stability of war-torn areas.

3. Opposing the nomination of Leland Olds to the Federal Power Commission.

4. Endorsing the Kerr-Thomas bill to amend the Natural Gas Act.

5. Opposing loans to Mexico for oil development.

I.P.A.A. Sees Winter Demand Greater Than Last Year by 472,000 Bbl. Daily

FORT WORTH. — Total United States demand for petroleum products during the coming winter will be 472,000 bbl. per day greater than last winter and will average 6,710,000 bbl. per day during the 6 months ending March 31, according to a forecast presented to the Independent Petroleum Association of America by its supply and demand committee.

However, new supplies needed to meet this demand will be only 6,405,000 bbl. per day, or 105,000 bbl. less than last year, because the committee estimates that stocks will be reduced by an average of 305,000 bbl. per day. Since stocks were built up on an average of 272,000 bbl. per day last winter, the anticipated stock changes mean that the new supply needed will be 577,000 bbl. per day less than if stocks remained unchanged both years.

Domestic sources could supply 6,290,000 bbl. per day of crude and natural-gas liquids during the fourth quarter of this year and 6,330,000 bbl. per day during the first quarter of 1950, the committee declared, so that no imports at all are needed during this quarter and only 190,000 bbl. per day next quarter.

However, the committee pointed out, imports currently are about 600,000 bbl. per day and are expected to exceed 700,000 bbl. per day by the end of the year, thereby reducing demand for domestic production by about that amount.

The accompanying table gives the committee's forecast for the coming winter.

PETROLEUM SUPPLY AND DEMAND FORECAST WINTER SEASON 1949-50
(Thousands of barrels daily)

	Actual 1948-49 winter (Sept. 30, 1948, to Mar. 31, 1949)	Forecast 1949-50 winter — Fourth quarter 1949	First quarter 1950	Average six months Sept. 30, 1949, to Mar. 31, 1950	% change 1949-50 winter vs. 1948-49 winter	
Total demand (domestic and export)—						
Gasoline	2,389	2,600	2,400	2,500	+111	+ 4.6
Kerosine	375	410	440	425	+ 52	+13.9
Distillate	1,182	1,320	1,490	1,405	+223	+18.9
Residual	1,468	1,450	1,570	1,510	+ 42	+ 2.9
All other	826	920	820	870	+ 44	+ 5.3
Total	6,238	6,700	6,720	6,710	+472	+ 7.6
Change in stocks—						
Crude oil	+137	—110		— 55		
Products	+135	—300	—200	—250		
Total	+272	—410	—200	—305		
New supply required	6,510	6,290	6,520	6,405	—105	— 1.6
Crude runs to stills	5,579	5,700	5,740	5,720	+141	+ 2.5
Closing stocks (million barrels)—	Mar. 31, 1949	Dec. 31, 1949	Mar. 31, 1950			
Four principal products	252	250	230			
Other products	94	83	85			
Total products	346	333	315			
Crude oil	269	250	250			
Total	615	583	565			

Huge Foreign Production Gain Seen as Result of ERP Aid

by Bertram F. Linz

WASHINGTON.—Production of crude oil outside North America and Eastern Europe will be nearly 2,000,000 bbl. daily greater in 1953 than it was in 1948 if present expansion plans are carried.

This forecast is contained in a report of the Economic Cooperation Administration summarizing material compiled during recent discussions of the British and Dutch oil-expansion programs under the European Recovery plan.

The figures are based on estimates of the British, British-Dutch, and American companies and such other information as could be secured. They showed that total crude production (outside of North America and the Iron Curtain area) might increase from 2,952,000 bbl. daily in 1948 to 4,892,000 bbl. daily in 1953.

The American companies' reports showed that they plan to expand their production from 1,542,000 to 3,374,000 bbl. daily between 1948 and 1953, while the British and British-Dutch companies propose to increase their production from 1,316,000 to 2,272,000 bbl. daily.

Refinery Runs to Increase

Total refinery throughput would increase from 2,424,000 bbl. daily to 4,230,000 bbl., with American companies increasing their crude runs from 950,000 to 1,468,000 bbl. daily, the British and British-Dutch companies from 1,262,000 to 1,896,000 bbl., and other companies from 212,000 to 646,000 bbl.

A large part of the total increase is accounted for by the projected refinery expansion of the Marshall plan countries, which indicates that crude runs to stills would increase from 384,000 bbl. daily in 1948 to an estimated 1,280,000 bbl. in 1953 if all plans are fulfilled.

ECA officials explained that if, in addition to the output of their own refineries, imports of products into the Marshall plan countries reach the level now estimated by the major companies, western Europe would have a total of 1,442,000 bbl. daily of refined products available for consumption in 1953, compared with 902,000 bbl. daily in 1948.

However, an ECA spokesman said, the figures include considerable duplication such as the amounts which the British companies expected to supply other companies, including American, which American companies, at least, do not intend to buy from them.

It was emphasized that the ECA has not yet reached any conclusions as to the amount of Marshall plan money to be granted Europe for oil industry expansion, and will not do so until the OEEC submits the program which it will develop on the basis of these statistics. Accordingly, no estimates of the cost to ECA can be made at this time, but the agency has not yet approved any of the projects covered by the study.

Officials said the statistics will have to be analyzed against the estimated 1953 demand for oil, but indicate that there will be a surplus if all projects are carried out.

The figures show that exports of crude from North America will drop from 24,000 bbl. daily in 1948 to 4,000 bbl. daily in 1953, and of refined products from 190,000 to 108,000 bbl. daily. The total availability of crude, therefore, is the sum of these exports plus total production outside North America and Eastern Europe.

Louisiana's Oil Reserve Estimated at 2.4 Billion Barrels by A.S.M.E. Head

by R. B. Tuttle

OKLAHOMA CITY.—Crude oil and liquid hydrocarbon reserves in Louisiana are estimated at 2.4 billion barrels, James M. Todd, president of the American Society of Mechanical Engineers, said here at the society's petroleum-engineering conference.

Natural-gas reserves amount to 24 trillion cubic feet, Todd said further in discussing the petroleum industry in his home state. In his address before a large group of engineers Todd pointed out that Louisiana levies the highest severance tax on crude oil of the 26 producing states. Severance-tax collections for the year ending June 30, 1949, are estimated at $50,000,000 for the industry, or an increase of 177 per cent in 3 years, stated Todd.

The average royalty paid to landowners approximates one-eighth so that those who own land in Louisiana, or those to whom they sold their royalty interests, are receiving some $56,000,000 a year. The state, however, is the largest single royalty owner.

The total rentals, royalties and bonuses collected from the petroleum industry by the state of Louisiana for the year ending June 30, 1948, exceeded $27,000,000. In addition, the state tax on gasoline yielded $33,500,000 in 1948, said Todd, a consultant engineer of New Orleans.

Bert E. Hull, president of Trans-Arabian Pipe Line Co., outlined many of the problems involved in construction of pipe lines in the Middle East.

Native labor, import levies, and climatic conditions were cited as a few of the factors which added to the problems of normal pipe-line construction as practiced in the Western Hemisphere.

The society's 3-day technical program included 27 petroleum papers. Divided into 13 sessions the papers covered a wide range of subjects in the production, refining, and transportation branches of the industry. The petroleum section of A.S.M.E., reorganized in 1946, deals principally with the mechanical-engineering aspects of the three branches of the industry.

The 1950 conference is scheduled for New Orleans September 25-27.

Firms Lose Bid to Be Freed From Gulf Tidelands Leases

BATON ROUGE.—Thirteen major oil companies have lost their bid to be released from state offshore lease obligations during dispute of tidelands ownership.

The ruling was handed down by District Judge G. Caldwell Herget of Baton Rouge.

Judge Herget upheld board contentions that the companies had no right or course of action against it, and said the board was not empowered by the state legislature to suspend leases; that the district court had no authority in the case; that the state improperly was not named a defendant, and that the state could not be named as a defendant unless it gave its permission.

Companies affected by the ruling include The Texas Co., Kerr-McGee Oil Industries, Inc., Phillips Petroleum Co., Stanolind Oil & Gas Co., Sun Oil Co., Pure Oil Co., Pan American Producing Co., Continental Oil Co., Superior Oil Co., California Co., Shell Oil Co., Magnolia Petroleum Co., and Humble Oil & Refining Co. Shell Oil last week paid $125,585 to Louisiana State Land Office for rental on nine state oil and gas leases in Chandeleur Sound in the Gulf.

this week

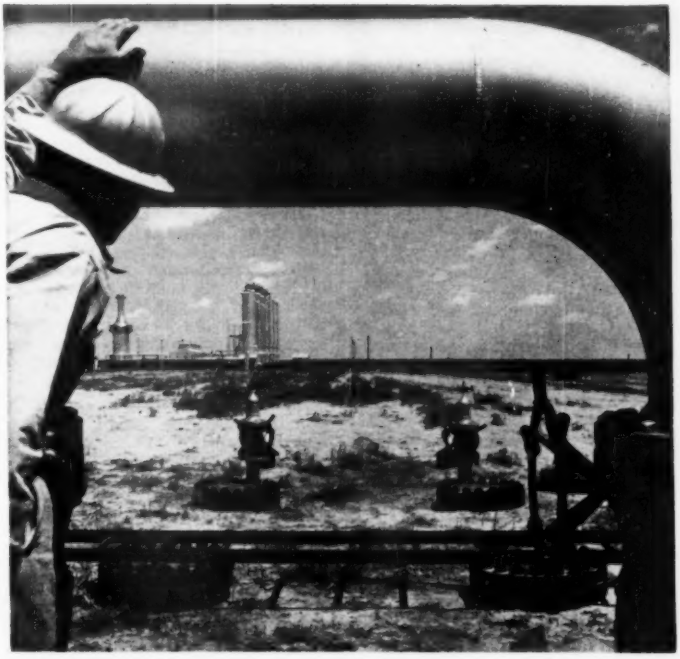
INDUSTRY—I.P.A.A. adopts resolution strongly condemning imports of foreign oil. . . . Speakers at annual meeting criticize U. S. aid to oil industry abroad as detrimental to domestic producers. . . . I.P.A.A. supply-demand committee forecasts winter demand 472,000 bbl. daily greater than that of last year. . . . ¶Louisiana's oil reserves estimated at 2.4 billion barrels by A.S.M.E. President J. M. Todd at Oklahoma City conference. . . . ¶Converted LST loaded by Kerr-McGee and Brown Drilling Co. leaves for Middle East to serve as floating field camp for exploratory drilling operations for American Independent. . . .

INTERNATIONAL—Haifa refinery scheduled to resume operations this week following 18-month shutdown. . . . Refinery to use Venezuelan crude oil. . . . ¶Military Junta in Peru issues decree inviting private oil interests to return to Peru and resume exploratory work. . . . ¶Four-power discussions in New York seek to determine exact extent to which Russia will continue to control oil industry in Austria. . . . ¶Number of rotary rigs operating outside the United States again shows decline in recent weeks. . . . ¶Two stepout wells in new Jose Ruiz field in Eastern Venezuela. . . . ¶Secretary of State Acheson reveals Pemex Director Bermudez was told that settlement by Mexico of claims resulting from 1938 expropriation would "improve the atmosphere" in loan negotiations, although settlement was not a requirement for the loan. . . . ¶Commerce Department denies report that oil equipment has been approved for Russia. . . . Rigs were electric blast-hole drillers, officials say. . . .

TRENDS—Crude-oil production averaged about 4,860,000 bbl. daily in September compared with 4,654,000 bbl. daily for the low week ended July 16. . . . ¶In the 5-week period ended September 24, stocks of crude and four major products decreased 4,735,000 bbl. . . . Crude dropped 7,266,000 bbl. and major products increased 2,531,000 bbl. . . . All of product increase was in California. . . . East-of-California crude and product stocks were reduced at the rate of 232,000 bbl. daily. . . . ¶Natural-gasoline and distillate prices continue upward trend in Mid-Continent area. . . .

GOVERNMENT—Six-month allowable plan proposed in Mississippi. . . . ¶British Government asks oil companies to make no price increases at present pending "full study" of devaluation situation. . . . ¶FPC Commissioner Leland Olds, renominated by Truman, lauded as champion of the people and pilloried as writer of radical articles advocating public utility ownership in hearing before Senate committee. . . . ¶ECA releases report showing crude-oil production outside North America and Eastern Europe will be 2,000,000 bbl. daily greater in 1953 than it was in 1948. . . . Expansion by British and Dutch interests to result in greater part of gain, ECA says. . . .

PIPE LINES—El Paso Natural Gas Co. now engaged in 1,168-mile construction program. . . . ¶Baxterville-Mobile line of United Gas Pipe Line Co. is completed. . . . ¶Ohio Fuel Gas Co. granted FPC authority to construct and operate new storage facilities. . . . Work will include new 60-mile gas line. . . .



Typifying the progress made in 1949 on construction of new pipe lines is this shot made at the new Hugoton compressor station of Cities Service Gas Co. The station is in Hugoton field near Ulysses, Kans. It serves on the company's new 400-mile natural-gas line from Hugoton field to Kansas City. In the background, framed by the gas-intake line to the dust scrubbers, are the petro-chem furnace and dehydrator contactor towers. The new line, which will deliver 270,000,000 cu. ft. of gas daily under a pressure of 900 psi., will be placed in operation officially in a ceremony October 12. Gov. Frank Carlson of Kansas will open a gate valve in a dedication ceremony at the South Glavin regulation station near Lenexa. Four other governors have been invited to participate in the event

At the speaker's table at the Colorado School of Mines, seventy-fifth anniversary banquet: W. E. Wrather, head of the United States Geological Survey; Dr. Carey Croneis, president of Beloit College and speaker at Thursday's convocation; Julius E. Krug, head of the Department of the Interior; Max W. Ball, petroleum consultant and former head of the oil and gas division of the Department of the Interior; Lee C. Knous, governor of Colorado; Ben H. Parker, president of Colorado School of Mines; and James Boyd, director of Bureau of Mines

Global Oil Policy Urged Before Colorado Minerals Conference

by Roy F. Carlson

GOLDEN, Colo.—The oil and mineral resources of the world belong to all the people and should be developed on an international basis without attempts at economic nationalism, speakers declared at a special minerals conference held in connection with the celebration of the seventy-fifth anniversary of the Colorado School of Mines here September 29-October 1.

"The owners and the consumers of the products of the earth will have to participate as partners. Our mineral civilization must be maintained in a morally civilized fashion. Thus the internationalized features of our economy are destined to become ever more broadly based geographically as the world becomes ever more closely linked culturally and socially."

Thus Dr. Carey Croneis, president of Beloit College, emphasized the international character of modern mineral engineering in an address stressing the need for broad and more philosophic thinking among the men of science and engineering.

Not Self Sufficient

Julius A. Krug, Secretary of the Interior, spoke in much the same vein, saying: "As we all know, the minerals taken from the earth do not really belong to any one corporation or to any one nation; they belong to all mankind. Considering the wide variety of minerals that we must import to satisfy the demands of American industry, a doctrine of economic isolation cannot be valid. No modern nation has ever been self-sufficient in minerals and no nation can attain that goal."

Krug pointed out that the minerals engineer performs his tasks against "a background of enterprise truly world-wide in scope." He referred to the recent United Nations scientific conference and utilization of resources with these words: "In summoning great men of science from the four points of the compass, those who issued the call remembered that science knows no political boundaries. They recognized that scientists—and specifically the engineers—are dedicated to the greatest of all tasks, that of applying the knowledge of man for the benefit of all. Possibly for the first time since its inception, the United Nations witnessed a convocation where all who attended were true representatives of one world. Because of the men themselves, the barriers of narrow nationalism and political ideology were broken down to permit open discussion of the questions which are basic to a decent living and a secure future."

Dr. Croneis developed the same thinking with these words, "It is my thesis that the very philosophies that are inevitably, if unconsciously, developed in all geologists and mining engineers through constant study of time, space, and resources could be especially helpful in the solution of our pressing governmental and social problems, both local and global. It is crystal clear that contrary to popular impression we are not an independent, but an extremely dependent, nation. We need the products of the mines and wells of many lands. But since our morally sound and practically wise national policy dictates that we acquire such resources without conquest, we now urgently require a farsighted global mineral policy."

Conferences held during the celebration included programs devoted to all phases of mineral industries, including metal mining, metallurgy, geology, petroleum refining and production, and geophysics. A general conference on world resources heard papers by S. G. Lasky of the U. S. Geological Survey on a "Mineral Resource Appraisal by the U.S.G.S.," and Max W. Ball on "Oil and Human Welfare."

Ball Lauds Industry

Ball, the former head of the Oil and Gas Division of the Department of the Interior, gave a vivid description of the importance of petroleum to modern civilization by saying: "No one knows how many people depend on oil for their employment. We have to guess. Here is a guess that is probably too low: that 85 workers in every 100 would lose their present jobs if our oil supply should fail; that directly or indirectly, 85 jobs in every 100 depend on oil."

"In 1850, the average wage earner worked 70 hours a week. Now he works 40. Man's hours of work have shrunk by 43 per cent since the advent of oil. In 1850 machine slaves did 6 per cent of man's work; now such slaves do 90 per cent. The evidence is clear. Oil is the great promoter of industrial progress; oil is the great contributor to a high standard of living."

In the geology conference Carrol E. Dobbin of the U.S.G.S. presented a paper entitled "The Petroleum Geology of Colorado." After first describing the geologic history of the area and the development of oil and gas in Colorado, Dobbin said that oil development in northeastern and southeastern parts of the state is

(Continued on page 381)

WASHINGTON WATCHING

BY BERTRAM F. LINZ

British Oil Safe

WASHINGTON. — Nationalization plans of the British Labor Government do not contemplate government ownership of the oil industry.

This was disclosed last week by Eugene Holman, president of Standard Oil Co. (N. J.), whose subsidiary, Anglo-American Oil Co., currently is spending $150,000,000 to expand its Fawley, England, refinery to 110,000 bbl. daily.

Adequate assurance that there would be no attempt to take over the business was demanded by the company before it undertook the Fawley expansion, and it is a foregone conclusion that had such assurance not been forthcoming England would have had to go without a plant which it is estimated will be able to supply approximately one-third of the country's requirements.

Ever since the Labor Government took Britain in the 1945 elections and announced its socialistic program of nationalization of industry, medical care, etc., there has been speculation as to whether the oil industry was one of those marked for seizure, although government officials never have given any indication that they were thinking seriously along that line. With the commitment given the oil company, the point is settled, definitely and finally, for the present government at least.

Holman also disclosed that a satisfactory agreement was reached regarding the convertibility of funds derived from the operations of the English subsidiary.

So far as operations of the oil industry as a whole are concerned, Holman said earnings this year would be around 25 per cent under those of 1948, but did not go into details.

Point-Four Pains

WITH the fading of the first flush of enthusiasm over President Truman's "Point Four" program, flaws in the scheme to encourage the economic progress of the world's underdeveloped areas are beginning to crop up and there already are suggestions that Congress will want to take a long look at the idea before it approves it.

Members of Congress who have been studying the subject are expressing less concern over the cost of the program than over the fact that it might run for 50 years or more.

Since foreign investment and international trade flourish only in peaceful times and there has not been a half-century in modern history without war somewhere in the world—even the peaceful United States has averaged close to a war a generation—the long period to which the program might drag out is a matter for serious consideration.

Another possibility of grave importance, however, has been added to the program in a recent report by the State Department on the progress of the program.

Some Washington observers see the heavy hand of government control in an assertion in the report of the important need "for coordinating all projects, private and governmental, in the same or related fields and areas."

"Careful planning on a country-wide or regional level will indicate priorities for technical cooperation that should prove helpful to private groups," the report said. This statement was made in connection with exchanges of technical skills and knowledge, and there was no indication whether such a policy would be extended to industrial investments abroad, but it was sufficient, nevertheless, to give rise to considerable speculation.

"Monopoly" Flare-Backs

WITH the administration and Congress making a big issue of the alleged absorption of American business by a few giant corporations, it came somewhat of a shock last week when Dr. Willford I. King, chairman of the Committee for Constitutional Government, showed a Senate committee studying monopoly that the Government's own statistics demonstrate that over the past 20 years the number of individual business enterprises has grown more rapidly than the number of corporations.

Further, King's figures disclosed, while the assets of the 25 largest corporations grew at a more rapid rate during that period than did the assets of all corporations, there has been no tendency toward a consistent increase in concentration of assets and, in fact, the concentration of net income has decreased markedly since 1940, now being much less than it was in 1936.

There are signs that the big corporations are becoming restive under the constant attacks to which they are being subjected and may eventually get up the courage to fight back. Crawford H. Greenewalt, president of du Pont, which is being sued by the Government, told newsmen last week that the ultimate size of a business concern is dictated "by the aggregate demand of its satisfied customers."

And, said Greenewalt, while the dictionary defines monopoly as exclusive control, the political interpretation seems to be that anyone who is big has it.

With all the investigations that have been made this year, the groundwork has been laid for an all-out legislative campaign next session to control big business in the interests of the "fair deal," but putting over that program may not prove as easy as it now looks.

What Price Government

A 7-WEEK deadlock on foreign aid funds was finally broken last week when House and Senate conferees agreed to provide $5,809,890,000 for operation of the European Recovery Program to the end of the current fiscal year next June.

But the two chambers, still disagreed over the Interior Department appropriation bill, almost immediately were involved in controversy over measures raising the salaries of top federal executives.

A bill passed by the House which would have provided a top salary of $25,000 for cabinet members and increase the pay of some 200 other officials brought protests in the Senate because civil servants would be receiving more than members of Congress in some instances, and the figure was cut to $22,500.

In line with that reduction, it was announced an effort would be made, in a companion measure covering salaries in the classified service, to provide a top of $12,500 instead of $15,000 for such jobs as that of director of the Oil and Gas Division, which now pays $10,000 and for which no takers have been found in nearly a year of search by Interior Secretary Krug and the National Petroleum Council.

Congress seems always to have been puzzled over the reluctance of important industry executives to jump at the chance of giving up high salaries to take government jobs paying, in comparison, starvation wages, when men fight so eagerly for legislative seats. Possibly one reason is that Congressmen are not investigated by Congress with the vigor and venom that it investigates department officials.

7 Days Completes a Well in

California's Latest Town-Lot Field

by K. B. Barnes and Robert Harwick

NEWHALL, Calif.—This small farming community of 1,500 population has a full-scale fever-pitch town-lot oil-field development at its back door. The new field has many of the aspects of the old-time town-lot drilling rushes—and all of the bustling activity and excitement that went with those feverish developments. But this one is in the modern style.

Big cat-type tractors scoop away the mountaintop terrain, build another new road, clear another new well location, and flatten out another new tank battery site in a day's time. Fast, efficient, portable rotaries bite down the 1,500-2,100 ft. to the producing sand in 5 days of actual drilling time. In all, it takes only 7 days for a well completion.

The wells come in flowing naturally for initial productions of 1,000 to 1,200 bbl. per day. One well came in for 2,700 bbl. With 250 ft. of oil sand or more to penetrate, this makes the new Placerita field, while small in present area, a very lively "oil orchard" indeed. It is producing approximately 32,000 bbl. per day.

The field lies 20 miles due north of down-town Los Angeles in the N½ NE 31-4n-15w, Los Angeles County.

Wells are being put down on as little as 1/20 of an acre. The activity has once more brought the California "town lot" drilling law into contest. This law stipulates that at least one acre must be held before a well can be put down. In the most recent court test, September 23, in Los Angeles, a hearing was held to clarify the status of a location of Metcalfe Oil Co., which was drilling a fractional acre tract in the field. The court held the law unconstitutional, and the company has continued its drilling.

TABLE SHOWING GROWTH OF FIELD

1949—	Bbl. dly.	Wells
September	*32,000	55
August	23,001	42
July	15,320	35
June	5,600	19
May	2,089	10
April	888	4
March	261	1

*Estimated.

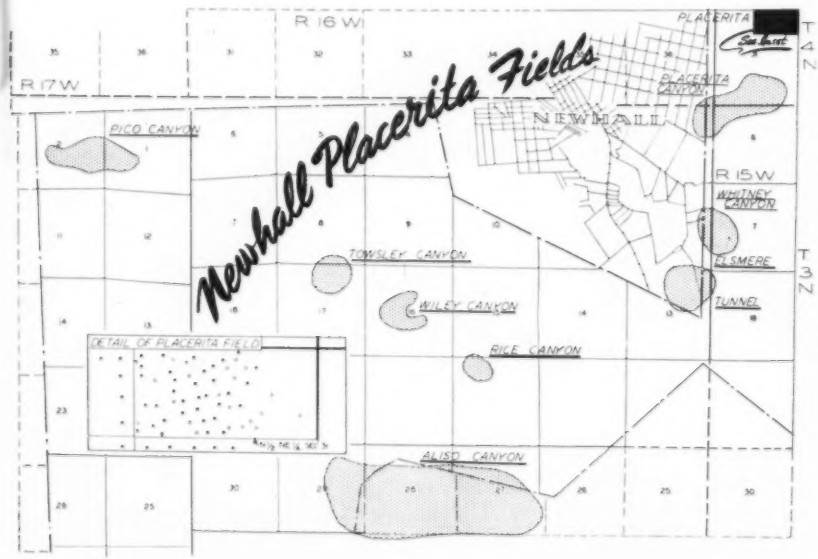
One of a Series

The new Placerita productive sector is one of a series of pools that comprise the Newhall field area. Newhall field is made up of a number of localized small productive areas strung along a narrow anticline in the Santa Clara basin. The present productive areas lie mostly in the canyons that cross the fold. The ruggedness of the terrain no doubt has partially restricted exploratory drilling to these canyons.

Discovery well at Placerita was brought in by Somavia Petroleum Co. at 1 Juanita, February 3, 1949. Subsequent drilling has been quite rapid. At the present time there are 55 producing wells and several new ones are being brought in each week. About eight rigs are now in operation. No dry holes have been drilled so far, in the new sector. There are five pumping wells, the rest are flowing naturally.

The oil accumulations in the Newhall area are in the Pleistocene and uppermost Pliocene. At the site of present activity the sand is definitely Pliocene but the sand itself has not as yet been given a name. Structurally, top of the sand ranges from 300 to about 475 ft. subsea. First 130 ft. of the sand at Placerita is coarse, well saturated, and is conglomeritic, with pebbles ranging from marble to fist sizes. The lower section is finer sand with some shale, and tighter. Gravity of the oil down-dip is about 18° but it rises, with structure, to 27° toward the top.

Early plans by Somavia to develop its holdings with wells spaced one to each 5 acres were abandoned when it was found impossible to bring any substantial area under unit lease.



Map of the Newhall-Placerita area. Black area upper right is Placerita field, shown in detail in inset. Representing a drilling-producing area of little more than 80 acres, the field is not typical of California operations. Virtually all California fields are produced under voluntary schedules or rates which reflect efficient reservoir performance without waste and maximum ultimate production. Many observers feel that Placerita emphasizes the need for state laws to regulate production, prevent waste, govern well-spacing, and aid unitization

Previous to the oil development this area had been divided up into 1/10-acre realty plots, and widely sold. Some 105 acres were involved, so when leasing and drilling were ready to commence there were, theoretically, a possible 1,050 land owners with interests in this small area. Subsequent sales, inheritances, and tax defaults also complicated the already difficult ownership picture.

Rothschild Oil Co., Santa Fe Springs, Calif., is the largest operator. Rothschild is producing 10,000 bbl. per day for its own account, has 18 wells, and is drilling 2. With Independent Exploration Co., Bakersfield, Rothschild also is producing 2,500 bbl. per day from five wells in the joint account. Rothschild has programed an additional eight wells, using three rigs. The operation of Somavia Petroleum and Tevis F. Morrow also are substantial. Somavia has 5 wells producing 5,000 bbl. per day, all flowing, and Morrow has 13 wells flowing a total of 10,000 bbl. per day.

Pipe Line Now Operating

The pipe line of General Petroleum Corp. is moving out production from Somavia, Morrow, and some of the other producers. The field price is now $1.32 per barrel, having recently been dropped approximately 85 cents.

The original five Somavia wells first penetrated only 90 to 100 ft. of the sand. After flowing 6 months, the production had declined to about 150 bbl. per day per well. Jack Beckham, field superintendent for both Somavia and Morrow, moved in tools and deepened the wells to take in another 150 ft. of sand. The wells when recompleted increased their flow to 1,100-1,200 bbl. per day through 2½-in. tubing, choked.

An idea of how rapid a pace is pursued in this development can be obtained from the record Beckham established in 13 wells on the Morrow leases.

In this instance, the first well location was made on August 13, 1949. By September 22, just a little over a month later, 13 wells had been drilled and completed and seven tank batteries set up. Concrete mats and electrical connections for the future installation of unit pumpers for the wells also were made.

In this same time interval more than 150,000 bbl. of oil was produced from the properties. During this same time Beckham also did the deepening work on the five Somavia wells. Five drilling rigs were used in this campaign. General Petroleum, during the time, also installed its pipe-line gathering system.

The General Petroleum pipe line is the only line serving the field at present. Rothschild Oil carries its production by tank trucks from the leases to its three refineries. Rothschild's tank trucks are now making 100 round trips a day between the field and the two refineries at Santa Fe Springs, and a third one leased from Olympic Oil Co., at Signal Hill.

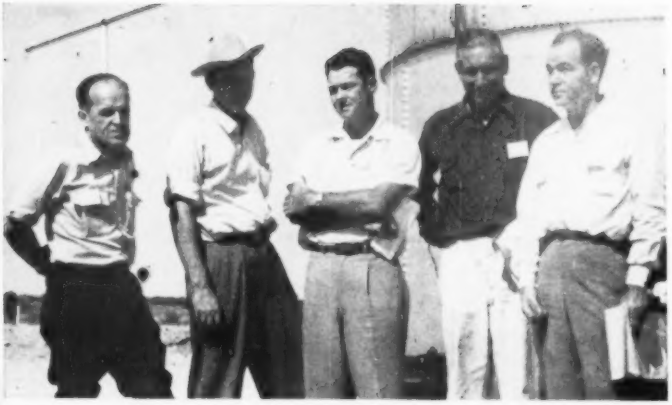
Placerita well locations are carved out of mountain-top terrain. The area was once a platted suburban subdivision to Newhall and divided into 1/10-acre parcels

At Placerita, to clear well location, drill, complete, and equip ready to produce including tank battery, the wells cost $30,000 each. The first wells have paid out in as little as 30 days and those at present are paying out within 1½ and 2 months producing time. How long this kind of payout return can be maintained is problematical, though, because the well density is constantly going up. The shallow depth to the producing formation and the thick sand section, of course, have acted in part as economic stimulation towards close well spacing. However, it is possible that this close spacing may become overdone, even with the necessities brought on by the competitive and broken-up lease ownership situation.

Drilling contractors represented in the field at present are Clyde Hall Drilling Co.; T. P. Pike Drilling Co.; Van Noy Drilling Co.; Pacific Drilling Co.; Terminal Drilling Co.; and C. M. and Kay Morse. Current drilling contracts are being written for $6.50 per foot, with day-work charges running $22 to $26 per hour depending on the services rendered.

Usual completion practice is to run 8⅝-in., 26 lb. casing with a Baker metal petal cementing basket used at the top of the sand, and an 18-row slotted liner, 100 mesh, 6-in. centers, hung through the sand.

Standing at left of Placerita's discovery well is Bob Harwick, California district editor of The Oil and Gas Journal, and Jack Beckham, field superintendent for the Somavia and Morrow companies. In this field Beckham established something of a record. In 39 days he was responsible for drilling 13 wells, redrilling 5, setting 14 stock tanks, and at the same time producing 150,000 bbl. of oil



Among one group of corrosion engineers and experts as they inspected a Gulf Oil Corp. tank battery in the highly corrosive McElroy field were, left to right, O. C. Muss, Shell Pipe Line Corp., Houston; B. R. Weaver, Tide Water Associated Oil Co., Midland; J. M. Mccre, Dowell Incorporated, Midland; F. Basket, Steel Coating Corp., Houston; and Roy Freeborn, Continental Oil Co., Hobbs, N. M.

Engineers Study Success of Field Anticorrosion Devices

by D. H. Stormont

MIDLAND, Tex.—The success of various coatings and other corrosion-prevention devices in shielding oil-field equipment from the savage attacks of sour crudes, brines, and hydrogen sulfide gases was evaluated by a group of 170 corrosion engineers and experts here last week.

Occasion for the study was the annual Permian basin corrosion inspection tour under the sponsorship of the Permian basin chapter of the National Association of Corrosion Engineers.

For 4 days, Tuesday through Friday, groups made field trips throughout the area to make on-the-spot inspections of corrosion-prevention activities at lease and pipe-line station tankage, oil-emulsion heating equipment, sucker rods and tubing, and at lease flow lines. In evening sessions reports then were given by group leaders on the status of the various installations inspected and on the effectiveness of the coating, chemical, or device. Round-table discussions were held and short papers read on various phases of corrosion prevention work.

Consensus of the group was that while some progress was shown in the effectiveness of protective coatings and other techniques, much more study and experimentation will be required before the area's corrosion problem is anywhere near solved.

In some of the lease tanks inspected on the tour, plastic coatings which had been applied 2 or 3 years ago were still in excellent condition. Yet, in nearby tanks where the same type coating had been applied the application had failed completely. Chemicals which had eliminated corrosion of rods and tubing in one well were found to have failed hopelessly in an adjacent well producing the same type of crude.

Among the many field installations visited during the 4-day tour were two lease lines which had been internally coated with plastic after the lines were laid. One job, 4,100 ft. of 3-in. line, had been performed in September 1948; the second 2,800 ft. of 4-in. screw pipe which had been laid originally in 1939, had been internally cleaned and coated in April 1948. Sections were taken from near the middle of each line so that the condition of the coating could be inspected; in both instances the coatings were intact and in good condition.

"How Coatings May Affect Corrosion," was given by Dr. F. A. LaQue, of International Nickel Co., New York, in the Tuesday night session, and on Wednesday evening O. C. Mudd, of Shell Pipe Line Corp., Houston, discussed progress being made by the N.A.C.E. LaQue's address dealt chiefly with types of electro-chemical corrosion which may occur when coatings are used and discussed methods of reducing the rate of attack.

At the Thursday evening session, Dr. W. J. Clayton of Minnesota Mining & Manufacturing Co., Detroit, presented "Effective Use of Vinyl Coatings in Control of Oil Field Corrosion." He emphasized the necessity for proper preparation of metal surfaces before the priming coat is applied if a lasting coat is to be secured.

Postwar developments in the use of "wash-primer" coatings were then dealt with, as well as the application of top coatings. The wash-primer coating he pointed out performs several functions; the metal surface is cleaned by the etching action of phosphoric acid contained in the coating, it provides a resin film to arrest corrosion, and increases the adhesiveness of the most overcoatings.

A. Gensberg, of Gulf Oil Corp., Odessa, chairman of the Permian basin chapter of N.A.C.E., presided at the opening session on Tuesday morning at which instructions for the daily tours were issued. Chairmen of the evening sessions were: H. Dean Murray, The Texas Co., Midland; W. H. Crewshaw, American Inspection Service, Midland; and Roy Zueteldt, The Texas Co., Jal, N. M.

Gossett Introduces Bill To Limit Oil Imports

WASHINGTON. — Legislation providing for a quota on petroleum imports, based on the amendment to the Trade Agreements Act unsuccessfully sought by Sen. Elmer Thomas of Oklahoma, was introduced in Congress last week by Rep. Ed Gossett of Texas.

The bill was introduced after President Truman signed the new legislation extending the reciprocal trade program and called for prompt ratification of the International Trade Organization charter.

Gossett's bill was referred to the House Ways and Means Committee, which is not expected to give it any consideration this year since Congress now is expected to adjourn within the next 3 weeks.

The President announced that he would use the authority granted by the legislation to proceed with further reciprocal trade agreement negotiations, indicating the possibility of further cuts in the oil import taxes. The bill gives him authority to reduce import duties to 50 per cent of the January 1, 1945, level. Previously cut from 21 to 10½ cents per barrel, the tax on crude and fuel oil could be cut to as little as 5¼ cents, but the rate on gasoline could not be reduced, it having been cut to 1¼ cents per gallon in the Geneva agreement 2 years ago.

International

WORLD-WIDE OIL DEVELOPMENTS

Foreign Rotary-Rig Operations Show Further Recent Decline

ANOTHER decline in the number of rotary rigs operating outside the United States has taken place in recent weeks.

A country-by-country tabulation indicates a drop of some 34 rigs in the August-September period. Some of these, however, cover operations suspended earlier and not reported until recently.

The September list with revisions shows a total of 391 rigs operating outside the United States. The figures exclude Russia and Russian-controlled areas, Germany and Japan.

Information compiled early in August indicated a total of 424 rigs running in the same countries at that time. In March, 457 rigs were reported in operation. The curve of rigs running reached a high point last November with a total of 499.

The most recent decrease is due first to economic conditions, and secondarily to the political situations in some countries. Slackened oil demand has caused various operations to be discontinued. Another factor is the currency situation in which government controls on dollar remittances have discouraged some drilling by American companies. Unsettled and unfavorable political conditions such as in Egypt and Denmark have also curtailed drilling.

Greatest Drop in Venezuela

The greatest part of the decline is in Venezuela. Ninety-three rigs are now reported running in this country—48 in the eastern and central section and 45 in the western area. This compares to 138 last March. In Venezuela the reason almost wholly lies in the drop in demand for heavy fuel oil. Operators are centering their efforts on the deeper and light crudes. Eight fewer rigs are running in Peru as a result of a remittance problem in this country and also the working off of a backlog of locations.

The tabulation of rigs operating in the Eastern Hemisphere showed less marked, though downward, changes.

OPERATING RIGS

Country—	March	August	September
	1949		
Alaska	2	2	2
Cuba	1	1	2
Mexico	37	37	37
Panama	1	0	0
North America	41	40	41
Argentina	50	45	43
Bolivia	2	2	2
Brazil	5	5	5
Chile	4	4	4
Colombia	24	18	18
Ecuador	11	12	13
Paraguay	2	2	2
Peru	21	20	12
Trinidad	22	22	23
Venezuela	138	114	93
E. Venezuela	67	56	48
W. Venezuela	66	58	45
South America	279	244	215
England	9	9	9
Denmark	2	1	0
France	12	12	12
Italy	7	7	7
Netherlands	6	6	6
Spain	3	3	3
Europe	39	38	37
Ethiopia	0	1	1
Algeria	2	2	2
Egypt	8	8	7
Fr. Equitorial Africa	1	1	1
Morocco	6	6	6
Tunisia	2	2	2
Africa	19	20	19
Bahrein	2	2	2
Iran	9	9	9
Iraq	6	6	6
Kuwait	9	9	9
Qatar	2	2	2
Saudi Arabia	7	7	5
Lebanon	1	1	1
Syria	3	3	3
Turkey	2	3	3
Middle East	41	42	40
Australia	2	2	1
China	3	3	3
Burma	2	2	2
Indonesia	15	15	15
Philippines	1	1	1
India-Pakistan	12	12	12
New Guinea	3	5	5
Far East	38	40	39
Foreign	457	424	391

Operations in Denmark have been suspended pending clarification of a government challenge to the concession. In Egypt, one operator has discontinued work pending favorable action by the government on exploration and development regulations. Saudi Arabia shows two fewer rigs running. This conforms to the general cutback in Saudi Arabian operations mainly as a result of exchange problems in marketing this dollar-produced oil.

Number of rotary rigs running is shown in the accompanying table.

Two More Stepout Wells Completed in Jose Ruiz

TWO more stepout wells have been successfully completed in the new Jose Ruiz field in Eastern Venezuela to establish the area as another producing reservoir for that section of the country.

The field is on a concession jointly owned by Pancoastal Oil Co., C.A., and Venezuelan Atlantic Refining Co., and operated by Venezuelan Atlantic.

No. 5, a 4,100-ft. stepout north of the discovery, was brought in September 26 testing 347 bbl. daily of 34.9°-gravity oil on a 9-hour test through ¼-in. choke. No. 6, located 4,000 ft. north of No. 2, also was completed as a producer, testing 400 bbl. daily of 36.2°-gravity oil through a ¼-in. choke. Three rigs are being operated in the field.

The five wells completed to date give the field a production potential of about 2,700 bbl. daily of 28.2°-36.2°-gravity oil. Construction has begun on a pipe line from nearby Sabath, and the first of five 10,000-bbl. storage tanks for Ruiz has been completed.

A new shallow well has been completed in Tucupido field about 15 miles north of Ruiz. This well, No. 203, was completed to produce 1,200 bbl. daily of 39.5°-gravity oil through ½-in. choke from a Chaguaramos sand at about 3,000 ft. The Betty sand was the primary objective but the shallow sand found at 3,000 ft. may be developed at the location. Compressor equipment for gas injection in Tucupido field is now being installed and may go in operation about the middle of October.

New Altona Refinery to Supply 50 Per Cent of Australia's Lube Needs

THE new Altona, Victoria, refinery of Vacuum Oil Co., Pty., Ltd., was built with a minimum use of imported equipment, and through its operations, is expected to supply about 50 per cent of Australia's requirements for industrial lubricants.

The 1,200-bbl. daily refinery began initial operations in July when the Stanvac Melbourne unloaded a 15,205-ton cargo at tanker-discharging facilities which have been built on the Yarra River and connected to the refinery by a 4½-mile pipe line.

Vacuum Oil is a subsidiary of Standard-Vacuum Oil Co. It has a major marketing position in Australia, and the new refinery marks its first processing operations in the country. Crude is being supplied initially from Venezuela's Tia Juana field. Later oil from Klamono field in western New Guinea will be used.

Built at a total cost of approximately $3,000,000, the Altona plant is designed to process heavy crude primarily for the production of asphalt and medium low-v.i. lubricating oils. It is located on a 200-acre site, about 60 acres of which are presently being used, approximately 10 miles from Melbourne on Port Phillips Bay.

Vacuum Oil first made the decision to build the refinery before the war. The project was held in the planning stage during the war, and actual work was commenced in October 1946.

The refinery was designed by Standard Oil Development Co. Of particular interest in its construction is the fact that more than 80 per cent of the material and equipment was purchased in the sterling area with the greater portion being supplied by Australian manufacturers. The imported equipment consisted of control instruments, specialized pumping equipment, and a few other items not obtainable in Australia.

Though a relatively small and specialized refinery, the Altona plant is expected to make possible a savings of about $1,250,000 annually in Australia's dollar-oil imports. This is in line with efforts of the Australian Government, which is now considering further restrictions on petroleum and some other commodities in order to meet its shortage of dollar exchange.

The Altona refinery is the first in Australia to manufacture lubricants. Shell of Australia now has under construction a 2,000-bbl. daily refinery at Geelong southwest of Melbourne which is scheduled to go in operation in 1951 and will produce lubricating oil along with other products.

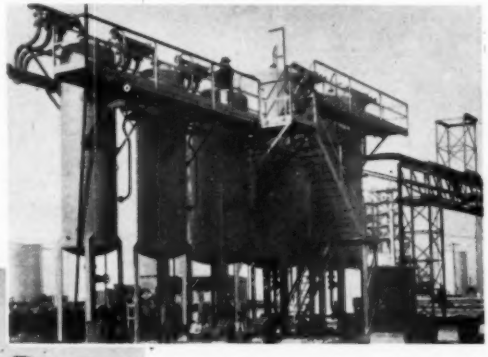
Prior to the opening of the Altona plant, Australia's refinery capacity was slightly more than 11,000 bbl. daily. This is in three plants with skimming and asphalt facilities. Australia's consumption of petroleum products has been increasing rapidly. Last year, it imported 26,591,000 bbl. of petroleum. Of this 2,636,000 bbl. was crude. Motor gasoline was 9,400,000 bbl., residual fuel oil, 7,991,000 bbl., and lubricating oil, 561,000 bbl.

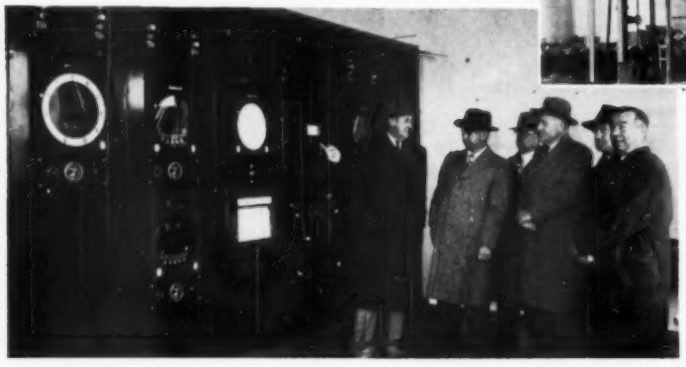
The new Vacuum Oil plant is designed to produce about 129,000 bbl. of diesel oil annually, 113,000 bbl. of asphalt and a small quantity of gasoline. The lubricating-oil facilities have a capacity for finishing about 300 bbl. daily of lubes.

Processing equipment of the refinery includes a two-stage atmospheric and vacuum crude pipe still. Gasoline and diesel are removed in the atmospheric tower while lube distillates are produced in the vacuum tower with asphalt being the bottom product. Lube treating and finishing equipment includes acid treating and neutralizing agitators and a vacuum rerun pipe still.

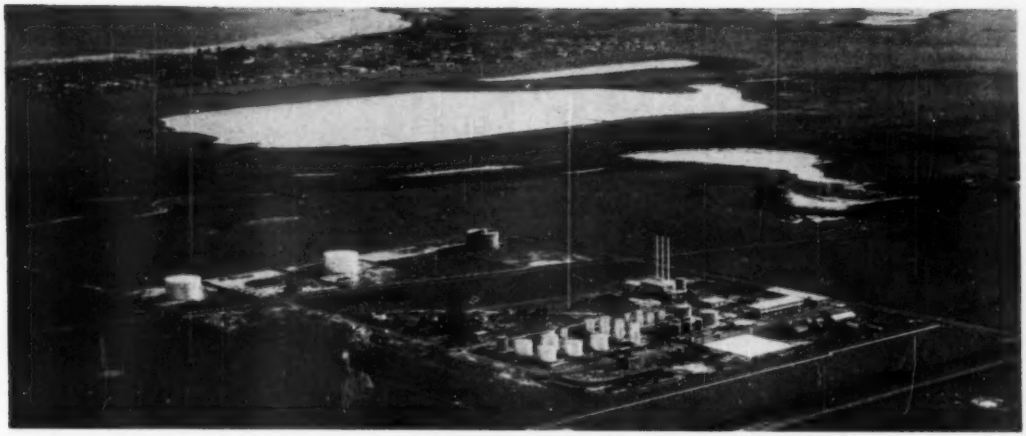
The stills were constructed in Victoria. Thompson's Foundry at Castlemaine produced two, and the third was built by Steelweld, Pty., Ltd., of Braybrook. The atmospheric unit is 62 ft. by 3 ft. 6 in., the vacuum, 69 by 6 ft. 6 in., and the vacuum rerun, 80 ft. in height.

Salt water for cooling at the rate of about 1,200 g.p.m. is drawn from the mouth of Kororiot Creek and





Above: Lubricating-oil blending plant of the Altona refinery with part of the fractionating tower and asphalt bulk storage tanks visible in the background. Left: Inspection party in the control room of the new refinery of Vacuum Oil Co., Pty., Ltd. In the group are S. G. Cruikshank, refinery superintendent; H. W. McCobb, director of Standard-Vacuum Oil Co., New York; A. M. Old, chief engineer, Vacuum Oil; Harold Rabling, chairman and managing director of Vacuum Oil; H. C. Smith, director of operations, Vacuum Oil, and R. N. Keppel, Standard-Vacuum Oil Co., New York



Aerial view of the new Altona, Victoria, refinery of Vacuum Oil Co., Pty., Ltd., looking southwest. In the background may be seen the town of Altona and Port Phillips Bay

brought to the refinery through a 1 mile, 18-in. pipe line. Effluent is returned to the creek through a larger line after treatment and separation of waste.

Refinery storage facilities total about 170,000 bbl. The tanks were manufactured in the country, using some 2,000 tons of Australian plate. Steam for process and other purposes is provided from three Babcock & Wilcox boilers.

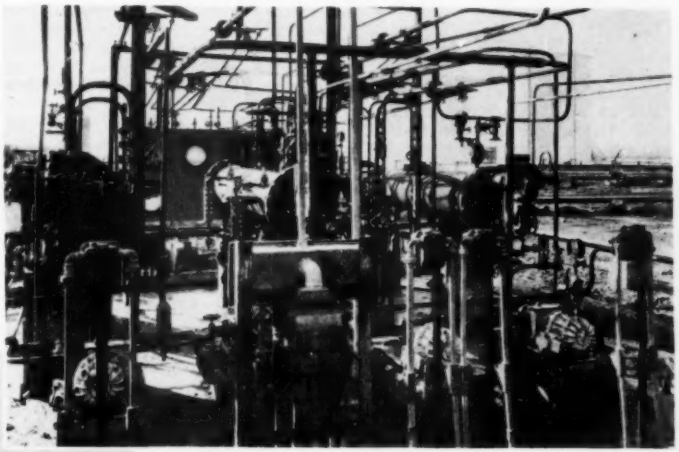
Will Use Local Labor

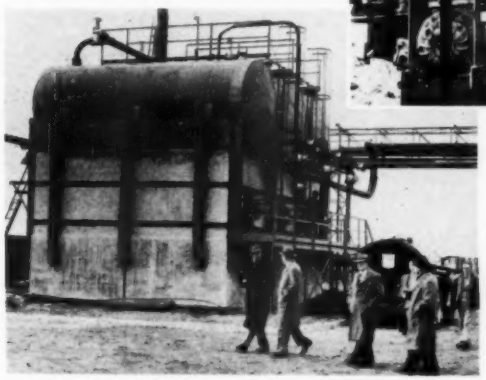
The refinery will employ about 100 persons and will be manned by an all-Australian staff. Auxiliary facilities include machine shop, laboratory, administrative building, and cafeteria.

During construction of the refinery, the shortage of steel in Australia made it necessary to obtain sizable quantities of steel rods, plates, sections, and other items from Army disposal sources in various areas, including the Pacific Islands. With supplies extremely limited in Australia, large quantities of cement were imported from England for concrete work and the manufacture of cement bricks which were used as a substitute for ordinary bricks which were at the time unobtainable for industrial construction work.

The Altona refinery was constructed under the over-all direction of H. C. Smith, director of operations for Vacuum Oil. Smith graduated from Melbourne University in 1920 and joined the company a year later as an assistant in the engineering department. A. M. Old, Vacuum Oil's chief engineer who has been with the company since 1928, supervised construction.

Superintendent of the new refinery is S. G. Cruikshank who joined Vacuum Oil in 1924 as a chemist. Cruikshank visited the United States in 1946 to study refinery techniques and confer with Standard-Vacuum engineers and officials.





Above: Light-oil treating plant in the Altona refinery. Left: Asphalt reheater unit at the Altona refinery

Russian Control Over Austrian Oil to Be Defined in Treaty

International

AN effort to determine the exact extent to which Russia will continue to dominate and control the oil industry in Austria is being made in four-power government discussions now taking place in New York.

The objective is a treaty which will end the occupation of Austria. It has been under negotiation for 2½ years, and one of the major points of difference has been Russia's claims on the country's oil properties.

Last summer, at the foreign ministers' meeting in Paris, it was decided that Russia would have a 60 per cent share of Austria's oil. Deputies failed to reach agreement on the details during their meetings in London in August, but it is a possibility some solution will be found in the current conferences in New York.

Reds to Gain Most

Regardless of the exact terms of the settlement, the treaty will represent a severe blow for non-Russian foreign oil interests in Austria. Russia will be able to gain an increasingly large proportion of the oil production since the Soviets will control much of the most promising exploration and development areas.

The Russian claims against Austria's oil industry are based on the fact that after the Anschluss with Germany in 1938, four predominantly German companies moved in and took over the properties by duress or other means. Russia contends it is entitled to these former Nazi assets.

After the Paris meeting, the Russians listed the following fields as those to which they were entitled as representing about 60 per cent of the country's production: Muehlberg, Alt-Lichtenwart (gas), St. Ulrich-Prinzendorf, Hauskirchen, Hohen-Ruppersdorf, Aderklaa (gas and some oil), and 50 per cent of Goesting.

The 60 per cent share was evaluated on the basis of the 1947 production of about 900,000 tons (approximately 16,800 bbl. daily). The Russian share is thus 540,000 tons (approximately 10,100 bbl. daily). The Russians also want five of the eight Austrian refineries.

Westerners Own Three

Three other fields are conceded to be owned by nationals of the western powers. They are the Van Sickle field, by R. K. Van Sickle Co., and Gaiselberg and Rag, by Rohoelgewinnungs, A. G. (known as Rag and jointly owned by Shell and Socony-Vacuum Oil Co., Inc.). The remainder of Goesting is left to Austrian interests. The status of another field, Maustrenk, is not clear. Whether it will be returned to Austrian interests or given to the Russians is not known.

The difficulty in the settlement lies also in the question of the future development of Austria's oil resources. The draft treaty gives the Russians 60 per cent of the development rights in their zone but as their 60 per cent, the Russians claim the entire Vienna Basin area which includes virtually all the proved and prospective producing land in the country. The settlement which is expected will thus result in surrounding the British and American holdings with Russian controlled territory. In these circumstances, the non-Russian interests will be forced out as their present properties are depleted.

Austria's current production is reported to be about 17,500 bbl. daily, though no exact figures have been available since the Soviet Mineral Oil Administration took control of operations in most of the Vienna Basin fields at the end of the war. Some of the reservoirs have been damaged by overproduction under Russian administration.

Early this year Russian drilling resulted in new production at Matzen about 18 miles northeast of Vienna. The discovery was on a structure mapped prewar by American and British interests.

Haifa Refinery To Resume Operation

THE 83,000-bbl. daily Consolidated Refineries, Ltd., plant at Haifa, Israel was scheduled to resume limited operations this week after a shutdown of nearly 18 months.

Two tankers from Venezuela carrying crude reportedly supplied by Shell discharged their cargoes at Haifa. The refinery was expected to operate initially at about 20,000 bbl. daily, less than a fourth of normal capacity. Further shipments of crude from Venezuela were anticipated.

The Consolidated plant, which formerly supplied products to many European and Mediterranean markets, has been closed since April 13, 1948, when Britain gave up her Palestine mandate and the Iraq Government refused to allow crude from Kirkuk field to move into Israel through the 12-in. pipe line. Consolidated is owned by Shell and Anglo-Iranian Oil Co., Ltd.

An Anglo-Iranian tanker, El Morro, carrying crude from Iran, was closely checked recently by Egyptian authorities at the Suez Canal after it was reported the oil was bound for Israel. The tanker was allowed to continue after the Egyptians satisfied themselves the crude was destined for Swansea, England.

The Arab nations, including Iraq and Egypt, which were involved in the Palestine war last year, have shown determination to block any crude from reaching Haifa. Last month, on the other hand, there were reports that the Israeli Government was threatening confiscation of the refinery unless it were opened.

The use of Venezuelan crude to reopen the refinery may cause Iraq officials to realize their stand is useless since the plant is operating without Iraq crude. The prolonged shutdown of the refinery and closing of the pipe line caused production in Iraq to be cut back, and the situation has resulted in major financial loss to both Iraq and Israel.

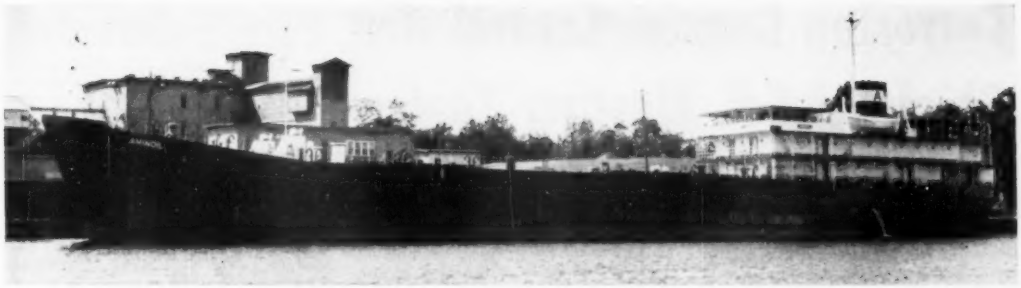
An expansion program had been announced for the Haifa refinery before it was closed down. A British steamer arrived in Haifa early in September with construction materials and equipment, and it is reported that some work is to be resumed. A unit to produce high-octane motor fuel will be completed along with a third cooling tower to serve this installation.

Peru Invites Private Oil Capital to Return

An invitation to private capital to resume exploration work in Peru has been made by the military junta now governing the country.

This was contained in one of a series of supreme decrees in which the government's oil agency was reorganized, the state-owned Empresa Petrolera Fiscal made a section of the Ministry of Public Works, and a new smaller group named to continue study of new oil legislation.

The actions of the military junta were considered an initial step in the direction of a more favorable attitude toward foreign oil capital. A revision of the basic Peruvian oil law is regarded as necessary, however, and another possible obstacle to foreign investment lies in the military character of the government and possible nonrecognition of its acts by subsequent administrations.



Side view of the 327-ft. Aminoil of American Independent Oil Co. which is carrying equipment and supplies of two drilling contractors to the Middle East, where they will conduct exploratory drilling in the Neutral Zone. The former LST shown here will serve as a floating camp and supply base

American Independent Sends Unusual "Field Camp" to Kuwait

ORANGE, Tex.—An air-conditioned, converted LST, carrying virtually all equipment and supplies needed to conduct drilling operations in the desert for a year, sailed from Orange September 30 en route to the Middle East.

The ship is the Aminoil, converted by American Independent Oil Co. into a floating desert oil-field camp. Anchored off the coast, it will be the operational base and warehouse for American Independent exploration and drilling crews operating in the neutral zone between Kuwait and Saudi Arabia.

The Aminoil was loaded by Kerr-McGee Oil Industries, Inc., and Brown Drilling Co., joint contractors for exploratory drilling in the Neutral Zone.

The first well will be drilled to test the area just south of Kuwait's Burghan field, which has a daily production of 20,000 bbl. and an estimated reserve of 11 billion barrels.

A drilling rig, road-building equipment, spare and replacement parts, and food were carried in large quantities. More than $40,000 worth of meat, for example, was placed in refrigerated lockers.

The drilling rig has been engineered for rapid movement and for ease of maintenance. Interchangeability of parts was emphasized in selection of engines, compounding machinery, and derrick equipment.

All rolling stock has been equipped with sand tires, and much of it has all-wheel drive. Special equipment for operation in the 130° temperatures characteristic of the area was included wherever possible.

The reconditioned LST has recreation, laundry, and dry-cleaning facilities installed. Every effort was made by the drilling contractors to preplan the ship as a floating counterpart of the drilling and producing camps now in the Arabian desert.

The Neutral Zone is a boundary area 50 by 40 miles lying between Kuwait and Saudi Arabia, with its eastern edge on the Persian Gulf. Control of the area is in the hands of both countries, and joint operation became necessary when both American Independent and Pacific Western Oil Co. were granted 50 per cent oil concessions. Under an agreement reached early this year, American Independent will complete exploratory work already started and drill a sufficient number of wells to test the area.

James MacPherson, vice president of American Independent and general manager of foreign operations, holds the Kuwait flag while Ralph K. Davies, center, president of American Independent, and N. P. Isenberger, vice president, examine it. Scene was the ceremony at Orange, Tex., just prior to the sailing of the Aminoil on its 12,000-mile trip to Persian Gulf

Have Plenty of Heating Oil On Hand, Thompson Warns

AUSTIN.—Crude purchasers were warned last week that "there is no excuse for a shortage" of heating oil this winter.

In a prepared statement issued at the same time that the commission asked for purchasers' nominations for November crude, Commissioner Ernest O. Thompson cautioned the industry to be prepared for expected heavy demand.

Senate Body Disapproves Olds' FPC Appointment

WASHINGTON. — A Senate Commerce subcommittee early this week voted unanimously against approving the appointment of Leland Olds to a third term as a member of the Federal Power Commission.

Immediately after its action, President Truman sent a letter to Vice President Barkley urging favorable action on the nomination in the Senate, where the appointment will be debated.

Corrosion Causes, Control Are Chief N.A.C.E. Meeting Topics

by D. H. Stormont

DALLAS.—Causes for and the means of controlling corrosion in refineries, pipe lines, and field storage tanks were the principal topics of discussion at the south-central regional meeting of the National Association of Corrosion Engineers held here October 3-4.

Control methods discussed varied from developments in protective coatings and use of magnesium anodes to use of ammonia in the vapor zone of large crude-oil storage tanks.

While much interest in the papers covering these topics was evidenced by the some 300 engineers and corrosion experts who attended the meeting, probably the outstanding attraction to most was the question-and-answer period held Monday afternoon. In this "off-the-record" session nearly all phases of corrosion were discussed, either by a member of the panel of experts or from the floor.

Moderator for this session was L. F. Scherer of Texas Pipe Line Co., Houston. The group of experts on the panel were: B. L. Corey, Socony-Vacuum Oil Co., Inc., Topeka; W. E. Huddleston, Huddleston Engineering Co., Bartlesville; F. L. LaQue, International Nickel Co., New York; H. Dean Murray, The Texas Co., Midland; W. F. Rogers, Gulf Refining Co., Houston, and C. A. Murray.

Statham Named Chairman

In the business session Monday morning, T. R. Statham, Magnolia Pipe Line Co., Dallas, was elected regional chairman for the coming year. Other new officials chosen were: George A. Mills, Central Power & Light Co., Corpus Christi, vice chairman; M. C. Fleming, Phillips Petroleum Co., Bartlesville, secretary-treasurer, and Hugh Waldrip, Gulf Oil Corp., Houston, assistant secretary-treasurer. Thomas F. P. Kelly, of James E. Mavor Co., Houston, was selected as the group's national director. Houston was chosen as the site for the 1950 meeting.

"Use of Ammonia to Control Vapor-zone Corrosion in Storage Tanks," by F. T. Gardner and A. T. Clothier, of Carter Oil Co., Tulsa, and F. Coryell, of Interstate Oil Pipe Line Co., Tulsa, gave the results of experimental field work in the North Louisiana-Arkansas area and near Billings, Mont.

Using anhydrous ammonia, because of its ease of introduction into the vapor zone, it was found a degree of protection against hydrogen sulfide gases ranging from 90 to 99 per cent can be had. Regarding the economics of the method it was stated that the method will result in a savings of over 88 per cent of the cost of uncontrolled corrosion, and will compare favorably with the cost of other means of protection such as coatings.

It also was pointed out that with protective coatings there is no refund on the investment if the crude stream changes from sour to sweet; using ammonia, protection can be applied only as long as needed.

Water Blamed in Gas Plants

In "Thermofor Catalytic Cracking Gas Plant Corrosion Survey," C. A. Murray, Pure Oil Co., Nederland, Tex., presented data which indicated the principal source of corrosion in the gas plant was the presence of water. Severe corrosion had been experienced in the plant for several years as was illustrated by inspection records showing metal loss and replacement. To determine the causes a complete chemical survey of the streams for the amount and type of corrosives, together with water present, was undertaken. In describing the results, Murray stated:

"It has been found that the corrosives, ammonia, hydrogen sulfide, and organic sulfur acids are distributed throughout the gas plant in the water phase. Liquid hydrocarbon streams are substantially free of corrosives, the ammonia in the system having extracted them in the water phase. Overhead stream corrosion has been most severe at points of greatest concentration of ammonia and hydrogen sulfide in the greatest amounts of water. Bottom stream corrosion has been most severe where ammonia salts of organic sulfur acids dissociate to give acid conditions which may cause rapid attack of reboiler tubes.

"To correct the situation, it was thought that entrained water should be removed through installation of added settling capacity and by adding entrainment separators where water is present in liquid hydrocarbon form. Further water then could be removed by installation of a flood nipple in the absorber tower and by installation of an entrainment separator prior to the depropanizer charge-bottoms exchanger. Murray stated the amount on water remaining after these proposed changes should be small, and that the remaining corrosives could be chemically neutralized.

Two other papers given in the Tuesday morning session were: "Selection of Protective Coatings for Fume Resistance," by C. C. Harvey, of Ethyl Corp., Baton Rouge; and "Let's Play Doctor," by William H. Crenshaw, of American Inspection Service, Midland. In the latter address the application of the remedy for internal corrosion of crude oil tanks was stressed, together with the steps necessary to bring about improvement of crude.

In a Tuesday afternoon address, J. A. Holloway of Houston Pipe Line Co., Edna, Tex., reported on the "Installation and Economics of Placing Magnesium Anodes at Leaks Repaired on a Pipe Line." He cited the experiences of the company in reducing the rate of corrosion at hot-spot areas by placing anodes at leaks repaired on bare Dresser-coupled lines where complete cathodic protection was considered uneconomical or scheduled for a later date. Case histories of jobs on nine 12 to 18-in. lines were cited.

Other papers at this session were: "Causes of Corrosion in Airplanes and Methods of Prevention," by N. H. Simpson, of Consolidated Vultee Aircraft Corp., Fort Worth; "Combating Corrosion in a Chemical Plant With Magnesium Anodes," by Oliver Osborn, of Dow Chemical Co., Freeport, Tex.; and "Experiences With Two Graphite Ground Beds in Dry Lakes," by R. J. Emerson, of El Paso Natural Gas Co., El Paso.

6-Month Allowables Are Proposed in Mississippi

JACKSON.—Hearings to establish allowable production of oil in Mississippi will be held once each 6 months for all fields not covered specifically by special rules, if a proposed amendment to Statewide Rule 28 is adopted.

A public meeting of the state Oil and Gas Board will be held at 9:30 a.m. October 20 in Jackson to consider the proposal. Under the amendment, hearings to establish allowable production of gas would be held each month. Orders fixing allowables for both oil and gas would be issued by the board on or before the twenty-seventh day of the month preceding the effective month of the orders.

Field Trip to Highlight South Texas Meeting

A 2-day field trip to study Cretaceous outcrops in the area west of San Antonio will highlight the sixteenth annual meeting of the South Texas Geological Society, October 28-30.

Opening day of the meeting, to be held in the Plaza Hotel in San Antonio, will be devoted to two technical sessions featuring papers on the South Texas area.

The field trip will begin Saturday morning, with the caravan spending Saturday night in Del Rio.

Swedish Firms Take Initiative, Ask Authority to Raise Prices

by Dahl M. Duff

NEW YORK.—Steps to increase prices of petroleum products abroad were initiated last week as scattered developments throughout the world made clearer the impact of the recent currency devaluation on the oil trade.

Swedish oil companies asked the government Control Board for permission to raise prices up to 44 per cent as a result of devaluation. It was pointed out Sweden buys from both sterling and dollar sources, though the price is quoted in dollar terms in both cases.

In South Africa, the prime minister announced a rationing plan for gasoline and indicated an increase in price will result from devaluation. In American domestic oil markets, some British orders for blended Texas and Mid-Continent lubricating oils were reported cancelled because of the new exchange rate.

No Change in British Prices

The British Ministry of Fuel and Power has requested oil companies in the United Kingdom to defer any price increases until it has had time to study the oil problem. Industry sources in London said the request would only delay the "inevitable" rise of sterling prices to dollar parity and pointed out that the government already has increased prices of certain metals as a result of devaluation.

The British marketing companies are now selling products at unchanged prices in the cheapened sterling, and face a loss in that some of their stocks must be replaced from higher dollar sources. Reports in London were that sterling prices of fuel oil and bunker diesels in areas outside Britain would be raised 40 per cent effective November 1.

The London Economist, considered to represent the intelligent British viewpoint, published a special analysis of the position of the petroleum industry. It said that sterling oil prices now need to be raised to reflect the diminished value of sterling and that "to talk of keeping oil prices after devaluation down to their former levels is, in the circumstances, nonsensical.

"The costs of American equipment, of oil production in Venezuela, of oil refining in Curacao, have been increased by 44 per cent at a stroke," it said. "The bolivar and the Curacao guilder have not been devalued, nor has the Iranian rial. American tanker freights are automatically made more costly; and if some of this increase is reduced, as times goes on, by a decline in demand for American tonnage, the increased demand for sterling tanker tonnage will cause sterling freight rates to rise.

"The oil development and refinery programs will in any case need revision in the light of higher costs (in sterling) of American equipment—which is still indispensable for any scheme in which early delivery plays a decisive part. It is clear that, if the prices of the products were to be kept unchanged while the costs of investment went up, the economic basis of some major schemes would become questionable."

The Economist pointed out that about 25 per cent of the petroleum products sold in Britain still comes from dollar sources. While the government could insist existing stocks be sold off at present prices, it indicated the British public will have to bear the increased element of dollar cost.

Althought the actual percentage amount of the British devaluation from $4.03 to $2.80 is 30.5 per cent, the number of pounds now required to buy the same amount of dollar goods as formerly is 1.44 thus showing that raises of 44 per cent are necessary to offset devaluation. Another aspect of the situation pointed out last week is that the British oil companies had their international prices raised automatically in practically all cases when devaluation went into effect.

This arises out of the fact that these companies have long quoted their prices on a dollars-and-cents basis with crude tied to an East Texas price and where sterling was to be accepted, providing conversion at the existing exchange rate. Thus crude might be sold f.o.b. Persian Gulf at $1.69 a barrel. Since devaluation, a proportionally greater amount of sterling is required to pay for such a shipment.

While the British companies are receiving additional amounts for their sterling sales, their costs in terms of dollars are up sharply. For Anglo-Iranian Oil Co., Ltd., leading Persian Gulf producer, additional costs in Iran are figured at 10 million pounds.

No Change in Iran

This is due to the fact that Iran has not devaluated its currency. Of the increase in costs, about 4½ million pounds will be for the higher sterling costs of wages in Iran and the other 5½ million for royalties to the Iranian Government. The royalties are based on gold, and the wages are fixed in Iranian currency which has stayed with the dollar.

In addition to the extra costs, Anglo-Iranian may have to pay an extra lump sum of about 3½ million pounds on certain past profits due to the Iranian Government. Under previous arrangements, the British Government undertook to provide hard currency to Iran for any imports not available as cheap or cheaper from Britain or soft-currency areas. Thus, devaluation has shifted part of the burden from the British Government to Anglo-Iranian.

Next Week

Progressive training program for refinery personnel at The Texas Co.'s Eagle Point, N. J., refinery is described in detail by the Journal's refining editor.

Effect of gravity loads on high-pressure pipe lines is discussed by Michigan's director of public utilities, the article describing tests conducted on a 22-in. line with ½-in. wall thickness.

Oscar Wolfe, Texas Co. consultant, continues his treatise on **the roughness problem** with respect to flow through commercial steel pipe and the direct solution of the Fanning equation for either the flow rate or diameter, which he began last week, and which will be completed in the October 20 issue.

Cyrus Pyle, du Pont engineer, analyzes several types of **control systems for distillation towers,** and illustrates his article with 18 diagrams.

Selecting the drill stem is a discussion of the importance of matching the capacity of drilling rigs to work to be done, so as to avoid overloading and high maintenance costs.

A related article, in a sense, is that by a California Standard engineer, which has to do with **balanced rotary rigs,** and how to achieve them.

Rig-to-office communications are proving highly efficient and economical, and an article will tell how to plan your installation and how to get maximum benefit from it.

The **operator's side of drilling-contract forms** is presented by a Magnolia author, who answers some points raised in an article that appeared in the September 22 Journal.

PERSONALS

H. B. Fuqua to Head Texas Pacific C. & O.

H. B. FUQUA was named to head Texas Pacific Coal & Oil Co., of Fort Worth, as chairman of the board, at the company's board meeting last week. He succeeds, in charge, J. R. Penn, who resigned as president, but who will remain a director and chairman of the company's executive committee.

Fuqua recently joined Texas Pacific after having been with Gulf Oil Corp. since 1922. He was graduated in geology from the University of Oklahoma.

Joining Gulf as zone geologist in the Wichita Falls district, Fuqua moved to Fort Worth in 1926. He was named chief geologist for the Fort Worth district, covering West Texas, North Texas, and the Panhandle, in 1929, and was later transferred to Houston as assistant to the vice president of production operations in the Southwest.

Prior to his transfer to Houston, Fuqua served as president of the American Association of Petroleum Geologists in 1937-38.

Penn's first association with Texas Pacific was in 1919, the year in which his company discovered the Ranger oil field. In 1920 he became a director and its president. He has been a director since that time, although he surrendered the presidency in 1927. He was reelected president in 1934.

C. E. Yaker has been named president of Texas Pacific Coal & Oil Co., Fort Worth. He joined the company in 1922 after graduating in geology from the University of California the same year. He became chief geologist in 1929 and in 1936 was made manager of the company's exploration. Yager was elected a director of the company in 1938 and promoted to executive vice president in 1944. He has pioneered in many of the producing fields of the Permian basin of West Texas and New Mexico.

Roy W. Thompson has been named technical assistant to **Daniel J. Hauenstein,** head of the Bayway oil movement and storage department, Esso Standard Oil Co.'s Bayway, N. J., refinery. He formerly was coordinator of the recently completed Bayway refinery expansion program. Joining Esso Standard in 1939 as a student engineer, he was transferred to Standard Oil Development Co. as chemical engineer, and 15 months later was assigned to the Bayway laboratory.

G. A. Younie, field superintendent in the Gorham, Kans., area for Stanolind Oil & Gas Co., has been named field superintendent in the Ellinwood, Kans., area, replacing **H. G. Nething.**

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Lester M. Snyder has been named vice president of Arabian American Oil Co., and will assist the president and executive vice president in the general administration of the company's activities, and will be responsible for coordination of domestic and foreign activities. Snyder joined Standard Oil Co. of California in 1931, and in 1939 went to Saudi Arabia as chief field engineer for Aramco. After returning to the United States in 1947 he served as assistant to the president.

E. A. Jenkins has been named general superintendent of the production department, Skelly Oil Co., Tulsa, replacing **A. A. Hunt,** who resigned. **Harry H. Haper** will replace Jenkins as superintendent of the company's southern district with headquarters at Velma, Okla. The company also disclosed that the Ark-La-Tex district, which was formerly in charge of Haper, has been combined with the Tyler, Tex., district, which has been in charge of **J. M. Sterritt,** and the entire Arkansas, North Louisiana and East Texas area is now known as the Ark-La-Tex district, under supervision of Sterritt. He will continue his headquarters at Tyler.

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W. J. B. DIXON

W. J. B. Dixon, formerly an assistant treasurer handling foreign financial matters for The Texas Co., has been appointed assistant to the vice president of foreign operations. **H. D. Teeters,** also formerly an assistant Texas Co. treasurer handling domestic financial matters, has been named assistant to the vice president of domestic operations. The company also announced that **Elihu Madison,**

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ELIHU MADISON

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H. D. TEETERS

who joined Texaco in 1947 as economist, has been appointed manager of the economics department.

William Ellison, power engineer at the Lockport, Ill., works of The Texas Co., has been transferred to the company's Sunburst, Mont., refinery.

J. P. Bradley, district foreman for Stanolind Pipe Line Co. at Bowie, Tex., has assumed supervision of company operations in the Bowie and Devol districts which formerly were under direction of **I. H. McVicker,** retired, and will supervise stations at Bowie, Graford, Kadane, and Bulcher. He joined the company in 1918.

L. F. Fischer, district geophysicist at Shreveport for Sohio Petroleum Co., has been transferred in the same capacity to the Lafayette, La., area.

George H. Bruce, Wichita, president of Aladdin Petroleum Co., has also been named production manager.

William W. Mayfield has been appointed superintendent of production and distribution in charge of field operating divisions, as well as leasing and geology, for Hope Natural Gas Co., Clarksburg, W. Va. He attended Columbia University and received a B.S. degree in mechanical engineering from Purdue University in 1933.

R. G. Greene has been appointed manager of exploration for the Pacific Coast area for Union Oil Co. of California, and will be responsible for both exploration and land activities. The company also announced the appointment of **Lon D. Cartwright** as chief geologist for all operations. He will be responsible for the correlation of all geological, geophysical, and exploration activities of the various divisions and will direct all activities outside assigned division areas. Other appointments include: **E. B. Noble,** named general manager for Canada, including exploration and development operations; and **E. R. Atwill,** appointed manager of the Rocky Mountain division with headquarters in Laramie, Wyo.

R. G. GREENE

L. CARTWRIGHT

L. N. Waterfall, formerly chief geologist, Pacific Coast division, Union Oil Co. of California, will resign November 1 to enter geological consulting practice. He first joined the firm at Casper, Wyo., in 1923, and after completing a period of study rejoined the company as geologist in Canada, California and Venezuela. He was named chief geologist, Pacific Coast division, in 1944.

Carl W. Wilson, district engineer at Premont, Tex., for Sunray Oil Corp., has been transferred to the Tulsa general offices, in the gas-engineering section. Other changes in the engineering department include: **J. Frank Dingee,** district engineer at Oklahoma City, named to replace Wilson at Premont; **Bob Parks,** engineer at San Antonio, transferred to Tulsa in the reservoir-engineering section; **G. D. Strother, Jr.,** Great Bend, Kans., engineer, transferred to San Antonio in the same capacity; **Thomas M. Allen,** Tulsa engineer, transferred to Wewoka, Okla., as engineer replacing **W. L. Gaither,** resigned; **Lee Pruitt,** now division engineer, named district superintendent for the Odessa area, North and West Texas division; **M. S. Patton,** formerly Gulf Coast engineer, Alice, Tex., moved in the same capacity to Midland; **Bill Yinger,** engineer, transferred from Midland to Oklahoma City; **W. A. Drain,** head roustabout in Scurry County, Texas, on temporary assignment, transferred back to Wewoka, Okla., district; **Lloyd L. Peek,** Forsan, Tex., transferred to Scurry County, Texas, as district foreman from Big Spring, Tex., district; **Jay Newcomb,** Odessa, Tex., named to replace Peek at Big Spring; and **A. J. Wise,** district foreman at Perry, Okla., transferred to Comanche, Okla.

F. H. Rheese, Sinclair Oil & Gas Co., Tulsa, has been named general superintendent and all division superintendents will report to him in Tulsa. **H. J. Summy** resigned as division superintendent in Texas and the following changes have been made: **R. A. Wright,** division superintendent at Casper, Wyo., moved to Midland, Tex., as head of the West Texas-New Mexico division; **Floyd Brett,** assistant division superintendent for the Northeast Texas division, appointed division superintendent with headquarters at Fort Worth; **D. M. Engle** named superintendent in charge of the Texas Gulf Coast division at Corpus Christi, and **T. C. Preston,** now district superintendent at Houston, named assistant division superintendent and moved to Corpus Christi; and **J. A. Jackman,** now district superintendent at Casper, Wyo., named assistant division superintendent of the Wyoming-Montana division.

Larry Twining has returned to his work in the geophysical department of Socony-Vacuum Oil Co., Inc., in Cairo, Egypt, after spending several weeks in the United States on business and vacation.

William H. Beckhuis, economic counselor associated in manufacturing activities for Standard Oil Co. of California, has been elected a vice president of the firm by the board of directors. He formerly served as assistant controller and has acted as secretary of Standard's executive committee for the past 6 months. He is a graduate of University of California.

Bobby L. Short, junior gas engineer for Sun Oil Co., has been transferred from the Dallas office to Sun's Delhi, La., gas plant. Other production department shifts include: **Marshall Dayton, Jr.,** from junior petroleum engineer trainee to junior petroleum engineer, with headquarters in Corpus Christi; **Nelson J. Sapp, Jr.,** from trainee to junior petroleum engineer at Robert Lee, Tex.; **Lee Thronson,** district petroleum engineer at McAllen, Tex., transferred to Corpus Christi; **C. W. Underwood,** petroleum engineer, transferred from Premont, Tex., to McAllen; and **W. J. Turner,** petroleum engineer, moved from Robert Lee to Premont. **C. C. Bengtson,** district petroleum engineer at Corpus Christi, was moved to Dallas.

Phil Bolin, Wichita Falls independent operator, was recently named chairman of the secondary recovery committee of the North Texas Oil and

Officers of the Central Oklahoma chapter, American Petroleum Institute, are shown at the first fall meeting in Oklahoma City. Front row, left to right: W. W. Heavner, Continental Supply Co., newly elected vice chairman for membership; J. A. Kornfeld, Sohio Petroleum Co., newly elected vice chairman for programs; G. E. Saunders, Sohio Petroleum Co., secretary-treasurer; Brad Mills, Dallas, executive vice president, American Association of Oil Well Drilling Contractors, principal speaker. Back row, left to right: W. R. Gottschall, Continental Supply Co., Dallas, formerly vice chairman for membership; Joe H. Field, Sohio Petroleum Co., chairman, advisory committee; and W. M. Edinger, Production Engineering Laboratories, chairman. S. H. Rockwood, Shell Oil Co., Houston, former vice chairman for programs, was not present when picture was taken

PERSONALS

Gas Association, and **V. E. Lewis,** Continental Oil Co. engineer, was named vice chairman of the group. The secondary recovery committee, in cooperation with U. S. Bureau of Mines officials, is making a survey of water flood projects in North Texas.

R. L. McGirr, Chickasha, Okla., rotary drilling foreman for Ohio Oil Co., has been transferred by the company to the Eureka, Kans., area, in the same capacity.

R. G. Clark, chief engineer, Utah Oil & Refining Co., Salt Lake City, has been named refinery manager, a newly created position. Other changes within the refining department include: **R. C. Watkins,** formerly assistant refinery superintendent, named refinery superintendent; **George E. Hinckley,** chief operating foreman, named assistant refinery superintendent; and **H. M. Thomson,** assistant chief engineer, named chief engineer succeeding Clark. Clark joined Utah Oil & Refining in 1922; Watkins joined the firm in 1922; Hinckley became affiliated with the company in 1928; and Thomson has been with the organization since 1933.

Joe C. Rolls, petroleum engineer at Grand Rapids, Mich., for Sohio Petroleum Co., is now serving in that capacity in the company's Oklahoma City offices, specializing in production problems.

D. W. Hovey, president of the Gulf Coast Refiners Association, Houston, has been appointed a member of the National Petroleum Council.

Marvin L. Drabkin has joined the chemical - engineering department, University of Pittsburgh, as a graduate research assistant. He formerly was engineer for The Texas Co.

Arthur C. Kreutzer, counsel and secretary of Liquefied Petroleum Gas Association, has been named managing director of the organization, succeeding **Howard D. White,** executive vice president, who recently resigned.

William G. King, Jr., has been elected vice president of Richfield Oil Corp., Los Angeles, and appointed sales manager, succeeding the late William T. Dinkins. King has been associated with the company for 20 years, and until his new appointment served as assistant general sales manager.

T. Dean Mundorf, geologist for Gulf Oil Corp. at Grand Junction, Colo., has been transferred to the Topeka, Kans., area in the same capacity.

F. P. McIntyre, drilling foreman at Donaldsville, La., for Shell Oil Co., has been promoted to division drilling foreman at Franklin, La. **D. J. Wilson,** drilling foreman at Franklin, has been transferred to Donaldsville, La., in the same capacity, and **W. A. Allred,** seismologist assistant, has been transferred from Jackson to New Orleans.

R. C. Granberry, assistant division petroleum engineer at Corpus Christi for Humble Oil & Refining Co., has been promoted to petroleum engineer, Southwest Texas division, Corpus Christi. **Sam Barclay, Jr.,** supervising petroleum engineer, Houston, has been transferred to the Southwest Texas division as assistant division petroleum engineer; **W. J. Greenwald,** supervising petroleum engineer, Southwest Texas division, has been transferred to the Houston office in the same capacity; and **Clarence O. Boyd** and **Eddie A. Auld,** gang pushers, have exchanged jobs, Boyd transferring to the Talco district, East Texas division, and Auld moving to the Conroe district, Gulf Coast division.

William Dancer, landman for Pure Oil Co., has been placed in charge of the company's newly opened geological and land office in Denver. **Frank Gorham** will serve as geologist, handling activities in eastern Colorado, southeastern Wyoming, and Nebraska.

E. S. George, vice president, Houston Natural Gas Corp., has been named senior officer in charge of operations throughout the entire company. He formerly held the same authority in the Eastern division. **J. M. Young,** formerly superintendent of the Eastern division, is now general superintendent in direct charge of operations, exclusive of the Houston district.

Floyd D. Aaring, Gulf Oil Corp. petroleum engineer at Chase, Kans., has been moved to the company's general offices in Tulsa, in the same capacity.

C. R. Clark, geologist for Kerr-McGee Oil Industries, Inc., Oklahoma City, has arrived in Calgary, Alta., where he will review Canadian activities for the firm.

Gerald L. Schlessman has been named president of Oklahoma Oil Co. by the board of directors. **W. Dale Houston** was named vice president, and **William J. Bona** was named secretary - treasurer. **H. M. Crosby,** formerly vice president, and **Dwight H. Elder,** formerly secretary-treasurer, have retired from the firm.

SHIFTS—

Lee E. Pruitt, engineer, Sunray Oil Corp., Midland, to Odessa, Tex.; **R. F. Boswell,** engineer, Phillips Petroleum Co., Odessa, Tex., to Cut Bank, Mont.; **Patrick Daugherty,** engineer, McCarty & Coleman, Wichita Falls, Tex., to Norman, Okla.; **W. E. Gean,** superintendent, Hunt Oil Co., Goodpine to Jonesville, La.; **W. S. Wherry,** Stanolind Oil & Gas Co., Abbeville, La., to Houston; **George McAnally,** superintendent, Dixie Drilling, Monroe, to Homer, La.; **Justin F. Cooper,** refinery engineer, The Texas Co., Lawrenceville, Ill., to New York City; **Miles Cowden,** superintendent, Cooperative Refinery Association, Coffeyville, Kans., to Kansas City, Mo.

DEATHS

William Walker, 76, president of California Commercial Drilling Co., died September 18. He formerly served as vice president and general manager of sales and the marine department of General Petroleum Corp.

William O. Whiteside, 48, vice president of Byrd-Frost Oil Co. and superintendent of its Longview, Tex., plant, died in Paris, Tex., recently.

Dr. Virgil R. D. Kirkham, 55, former professor of geology, University of Chicago, died in Spokane, Wash., September 25.

Ray T. Moore, 55, independent oil producer and member of the New Mexico oil-development firm of Ramco Corp., died in Oklahoma City September 29.

Edward Justus Wrightson, Jr., Houston, engineer for Ada Oil Co., died September 22.

M. J. Munn, 75, former geologist for the old Gypsy Oil Co. and one of the founders of Riverland Oil Co., died in Texarkana, Tex., October 2. He was a native of Hope, Ark.

Donald S. Shadle, 51, general manager of R. & S. Oil Co., Long Beach, Calif., died in Mayfair September 23.

J. E. Lassiter, 53, director and general sales manager, Houston Oil Field Material Co., died September 25.

Annual PIPE LINE Number

IN this most active pipe-line year of petroleum and natural-gas history, this issue is devoted to the activities of those who have the responsibility of design, construction, and operation.

The section opens with a several-page "On The Line" picturization of major construction jobs recently completed or under way at this time, with a discussion of trends as reflected by actual developments of the past year.

Pipe-line mileage in 1949 will be substantially ahead of last year, and even greater construction is planned for the future. The trend toward large-scale operations continues, with builders and owners making use of new practices.

New advances in pipe-line techniques are discussed in a series of articles which were prepared exclusively for the Journal by engineers and other technologists of the pipe-line industry. Mathematical discussion of fluid flow, steel pipe strength, improved practices in design, operation, and maintenance of pumping and compressor stations, new features of pipe-line construction, and procedures for more effective corrosion control, are among the subjects discussed. This material is designed to keep the pipe-line industry abreast of technological developments in planning and methods in order to assist it in accomplishing the big construction and operating job ahead.

A complete construction report, another exclusive feature of the issue, details the individual projects planned in the United States and abroad for the transportation of crude oil, petroleum products, and natural gas.

Plus A FOUR-COLOR WALL GUIDE TO THE PRINCIPAL NATURAL-GAS PIPE LINES IN THE UNITED STATES

PRESENTED BY THE OIL AND GAS JOURNAL

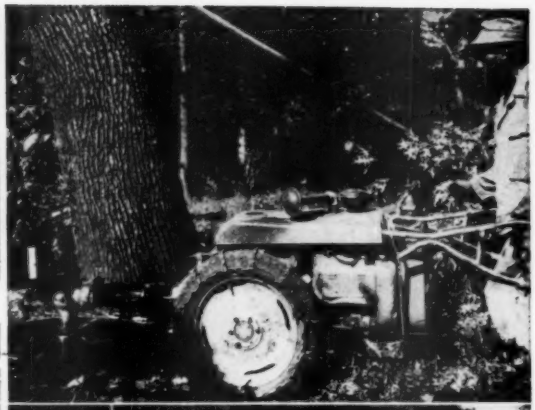
ON THE Line

by Paul Reed
Pipe-Line Editor

GREATER efficency is the goal of those who currently have the responsibility of laying thousands of miles of pipe line yearly and whose duties also include the installation of the equipment with which the lines are operated. This trend is apparent in all the major projects completed this year and those under way at this time.

In the current evolution of pipe-line techniques significant procedures are contributing to the speeding up of big-inch spreads operating with $700,000 equipment and $5,000-$10,000 daily expense. New 1949 practices have promise of greater future application. These include double jointing in yards and on the line, cradling into the ditch, smooth bending, and certain other features relating to ditching, welding and associated activities.

An outstanding feature of 1949 big-inch construction is the procedure sponsored by Fish Constructors, Inc., for double jointing 30-in. pipe by automatic submerged arc welding for expediting the work of spreads operating in Louisiana and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The sequence of pipe-line construction photographs for this article were mostly taken on the job by the author. Some came from contractors. These show operations at important 1949 projects of Michigan-Wisconsin Pipe Line Co., Tennessee Gas Transmission Co., Texas Gas Transmission Corp., and Texas Pipe Line Co.

1—Power-driven disk saw cutting trees in clearing right-of-way near Eudora, Ark., for the Texas Gas Transmission Corp. 26-in., Carthage, Tex.-Middletown, Ohio, line, in a section contracted by Latex Construction Co. . . .

2—Bulldozer pushes felled trees, branches and debris off the right-of-way of the above project . . . .

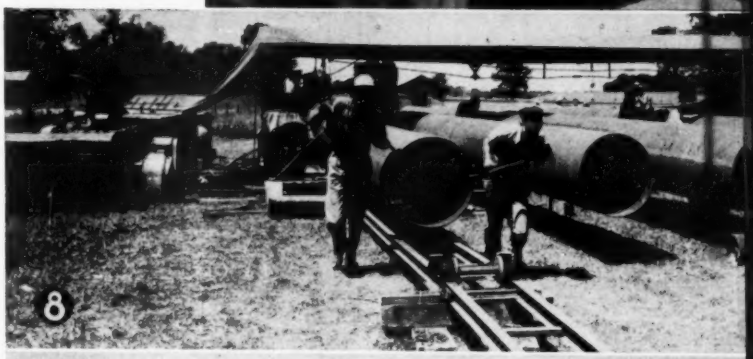
3—Modern wagon drills handled in pairs by boom tractors speed up preparations for shooting for Tennessee Gas Transmission Co. loop near Campbellsville, Ky., laid by Anderson Brothers Corp. . . .

4—Instead of shooting in Kaliche country near Corsicana, Tex., for a Texas Pipe Line Co. project, Smith Contracting Corp. ripped up the soapstone with an 18-ft. steel plow towed by two tractors. The plow was fabricated on the right-of-way by the contractor's welders. . . .

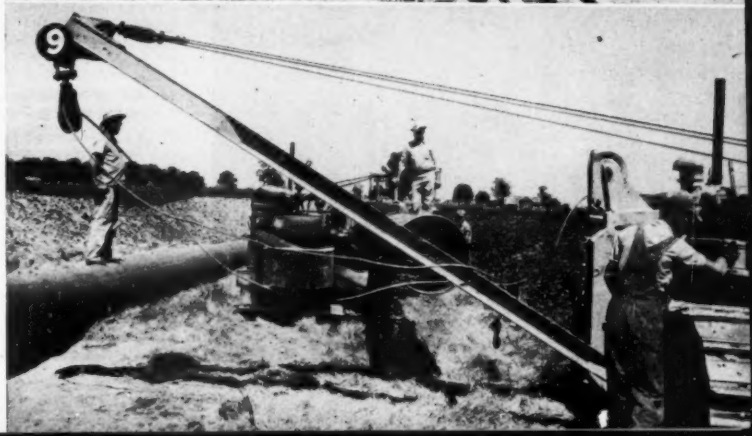
5—Large ditcher digging 36-in.-wide ditch, deep enough to provide 30-in. cover for 26-in. pipe laid for Texas Gas Transmission by Latex . . . .

6—Two backhoes working just ahead of the pipe gang in a Mississippi section of Transcontinental Gas Pipe Line Corp.'s Texas-New York line contracted by Morrison Construction Co., Inc. . . .

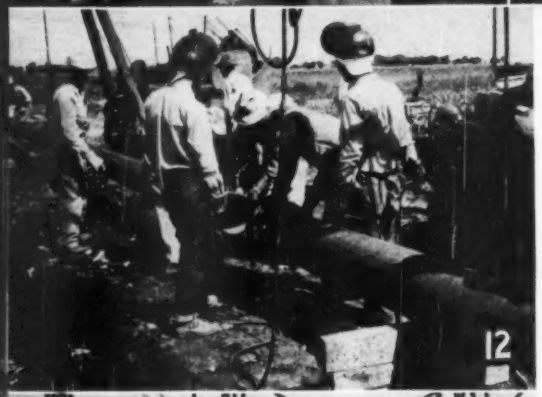
7—Automatic submerged arc welding for double jointing 31½-ft., 30-in. joints to form 63-ft. joints for the Transcontinental Gas Pipe Line Corp. line. This plant, operating west of Baton Rouge, is one of the two portable units operated by Shamrock Construction Co. Welding rod in the form of wire is fed from the reel at the left; granulated flux material flowing from the hopper at the right protects the hot weld-metal. The pipe is rotated by special turning equipment. Prior to applying automatic welding, a stringer bead is run manually by all-position welding, with the pipe stationary . . . .



8—Moving a 63-ft., 30-in. joint away from automatic submerged arc welding equipment immediately after completion of double jointing. Light conveyor, rotating unit, and welding equipment are moved and set up in a new location within 10 to 23 miles in a day's time. Movement of pipe in the yard is facilitated by a ¾-yard dragline. Low stacks of pipe—three-tie for 31½-ft. joints and two-tier for 63-ft. joints—reduce cost of yard-handling . . . .



9—Smooth bending 26-in. pipe for Texas Gas Transmission by Latex, with use of hydraulically operated machine which bends in compression around a die of fixed radius without decreasing outside wall-thickness . . . .



ON THE *Line*

Mississippi laying sections of Transcontinental Gas Pipe Line Corp's Texas-New York system.

This double jointing is done in two portable yards which weld two 31½-ft., 30-in. joints to form 63-ft. joints for delivery to the spreads of two contractors.

Advantages of such double-jointing work for the Fish-directed Transcontinental project bring several important economies: (1) Cost of automatic welding is regarded as cheaper than field welding; (2) half as many field welders are needed; (3) for bending 30-in. pipe, the 63-ft. joint is desirable since there are objections to bending pipe of this diameter in joints as short as 31½ ft.

While stringing trucks can carry only five 31½-ft. joints tney carry three to five 63-ft. joints depending on the condition of the roads. There have been no unusual problems in the stringing of 63-ft. joints in the Louisiana-Mississippi country where Transcontinental construction has been under way this year.

Furthermore, the handling of pipe in 63-ft. joints means that the pipe gang has only half as many line-up and stringer-bead operations. The actual gain in production in a given period for a certain pipe gang handling 63-ft joints has been estimated to be 40 per cent; it took about 10 per cent longer for manipulating the long joints than for the short joints. Increase in total output of all spreads working with 63-ft. joints is regarded as 15 to 20 per cent.

Thus the use of the longer joint relieves an expensive bottleneck in spread progress. For with good going, the other gangs in the spread can catch up with or keep ahead of the pipe gang, which normally sets the spread pace. The output of each of these double-jointing yards is 70 to 100 welds per 10-hour day (with a maximum of 110 welds).

Good solid stringer beads are vital for the success of automatic welding. Stringer beads are first run manually by four welders on pipe in a stationary position before being rolled to the turning device where pipe is rotated during the automatic submerged arc welding process. The quality of welds made by this method is regarded as superior to field welding.

10—Buffing beveled ends of pipe using portable power-driven machine (Texas Pipe Line Co., Smith Contracting Corp.) . . . .

11—Electric-operated internal line-up clamp in 34-in. pipe being laid near Hollister, Calif., in the San Francisco area, for the 510-mile line being laid from Topock, Ariz., for Pacific Gas & Electric Co. by Bechtel-Price-Conyes. By electric power from a portable unit, the clamp travels through big-inch pipe to line up internally so that stringer-bead operations are unobstructed . . . .

12—Lineup with external clamp preparatory to welding . . . .

13—Running stringer bead on 12-in. pipe laid for Texas Pipe Line Co. by Smith Contracting Corp. . . .

14—Finish bead run on Michigan-Wisconsin Pipe Line Co.'s 1,548-mile Texas-Michigan line in one of the sections laid by J. R. Horrigan Construction Co. . . .

ON THE Line

Although Transcontinental's double jointing with automatic welding is something of a novelty in the United States this year, it may be predicted that the practice will be extensively applied for big-inch construction in 1950.

In the Alabama section of the Transcontinental line, Midwestern Constructors, Inc., is double jointing on the right-of-way ahead of the pipe gang by the method that this organization and other contractors have used from time to time for several years.

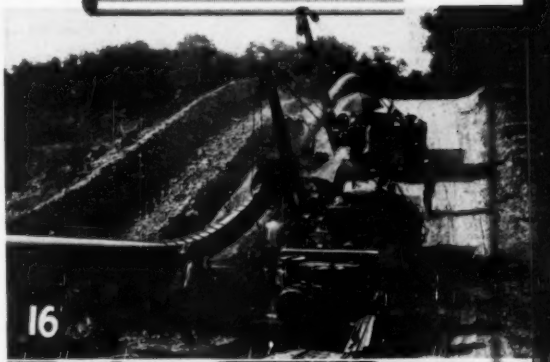
An interesting innovation for accelerating spread production is the use of two pipe gangs which began to attract attention in 1948. A spread of Morrison Construction Co. laying 30-in. this summer near the Sabine River in Texas for Tennessee Gas Transmission Co., laid with this method an average of 9,000 ft. per day prior to a rainy period which brought the average down to 6,200 ft. per calendar day—still a high spread rate.

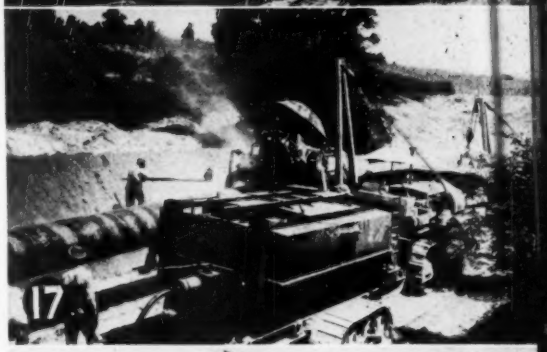
There is some speculation on the future possibilities of a light portable unit with automatic welding and turning equipment which could operate on a right-of-way ahead of the pipe gang.

Conspicuous in this year's operations is the widespread adoption of cradling into the ditch, a practice limited until recently to only a few organizations, including Stanolind Pipe Line Co. which has employed it extensively for some time. Cradling into the ditch is now being applied by certain major companies for laying pipe with diameters up to 26 in. By this method of lowering pipe directly into the ditch behind the dope machine it is possible to avoid coating damage resulting from supporting pipe on skids on the right-of-way. It also eliminates the usual lowering-in operations requiring sometimes as many as three or four large tractors.

For the rapid cooling of coating which is especially desirable with the cradling-into-the-ditch method, soaps or wetting agents have sometimes been added to make cooling water cling to the coating longer so as to be more effective in quickly reducing temperature.

Pads of dirt 4 to 5 in. high and 10 to 30 ft. apart have proved to be effective in supporting cradled-into-the-ditch coated pipe. J. R. Horrigan in laying for Michigan-Wisconsin Pipe Line Co. has been sprinkling the dirt pads with water. In laying certain sections of the Basin Pipe Line System, several pounds of enamel from a patching pot were poured on top of the pads.



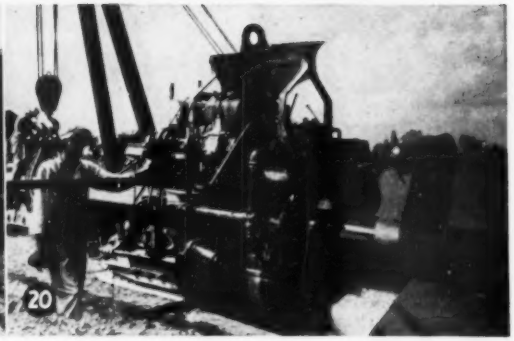


15—Setting up X-ray equipment placed on the outside of 26-in. pipe for inspection of welding for Texas Gas Transmission project. Operator at left is opening door of dark room on rear end of truck where negatives are developed on right-of-way. This X-ray unit uses either external or internal method according to requirements. The external method can be applied closer to welding operations but it requires twice as much exposure time as the internal method . . . .

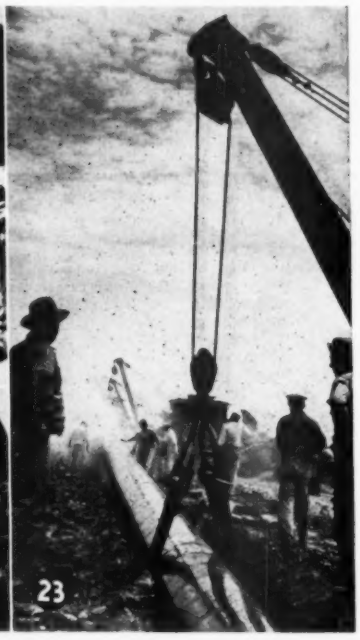
16—Cleaning machine and priming operations on big-inch loop for Tennessee Gas Transmission laid by Anderson Brothers in Kentucky . . . .

17—Dope gang applying enamel and glass-mat wrapping on 30-in. pipe cradled by two tractors in the laying of a Transcontinental section by Wunderlich & Griffis . . . .

18—The tractor ahead of the coating and wrapping machine is one of the tractors engaged in cradling the pipe. Catch-off tractor is in the rear of these doping operations for the Texas Gas Transmission job of Latex . . . .



19—Electronic jeep run along 30-in. pipe of Transcontinental as a routine procedure for detecting holidays in coating just applied by the dope gang seen in the distance . . . . 20—Dope machine simultaneously applying enamel, glass mat, and asbestos felt on 12-in. of Texas Pipe Line by Smith Contracting . . . .



ON THE Line

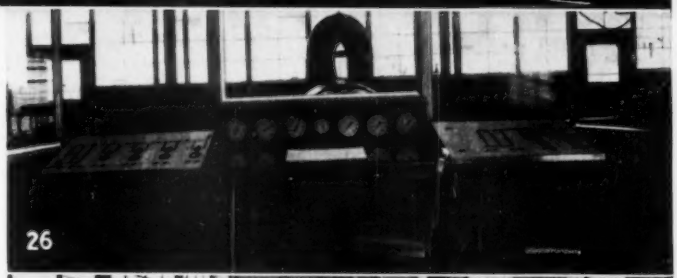
21—Lowering in 30-in. with three large tractors. The third tractor in the distance is coming up the right-of-way. (Transcontinental job of Wunderlich & Griffis) . . . .

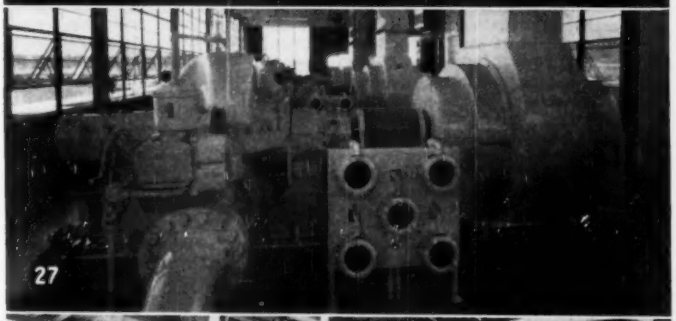
22—Cradling 12-in. pipe into the ditch on Texas Pipe Line project laid by Smith Contracting: man in white is running electronic jeep; water coming through hose from large tank wagon at right is sprayed through perforated pipe to cool hot coating on the pipe . . . .

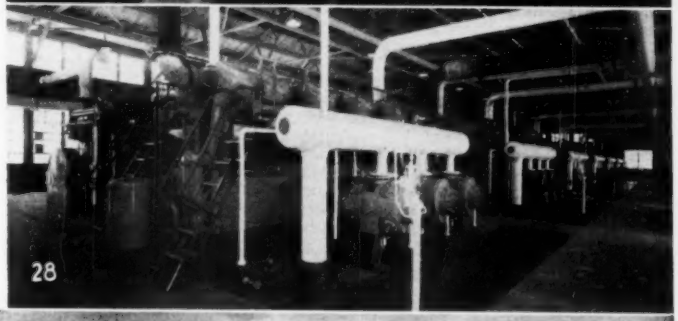
23—Cradling 26-in. into the ditch for Texas Gas Transmission by Latex using catch-off tractor with sling to facilitate control of the operation . . . .

24—Clean-up bulldozers finishing the job on Mississippi section of Transcontinental contracted by Wunderlich & Griffis . . . .

ON THE Line







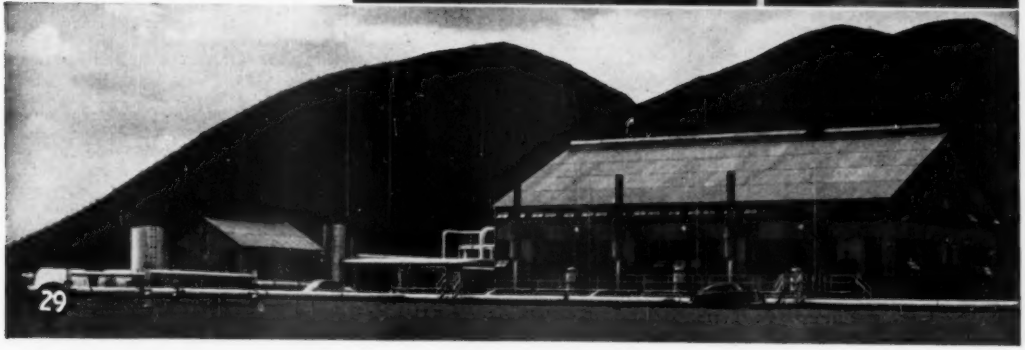
25—*Ozark Pipe Line System pump station at Cushing, Okla., where crude oil is received from the 516-mile line from Jal, N. M. This is the initial station on Ozark's 435-mile line to Wood River, Ill. . . .*

26—*Control panel with gages, push-button control, and illuminated diagram of piping, pumps, and valves at Ozark's Cushing, Okla., pump station. This panel is located in bay window jutting into pump room to give operator full view of pumping units . . . .*

27—*Basin Pipe Line System, Jal, N. M.-Cushing, Okla., electric centrifugal pumps at Midland, Tex., station . . . .*

28—*Guadalupe Pass, New Mexico, compressor station of El Paso Natural Gas Co. with 1,000-hp. units . . . .*

29—*El Paso Natural Gas Co.'s No. 2 booster station on the line from Texas to California*



CANADIAN CLIMATE *presents problems for*

INTERPROVINCIAL PIPE LINE

by Whitney G. Sexton

ENGINEERING and survey work is well advanced for Interprovincial Pipe Line Co.'s contemplated 450-mile 20-in. crude line from the oil fields in northwestern Canada to refineries at Regina, Sask., with 700-mile 18 and 16-in. extension to a shipping terminal at Superior, Wis.

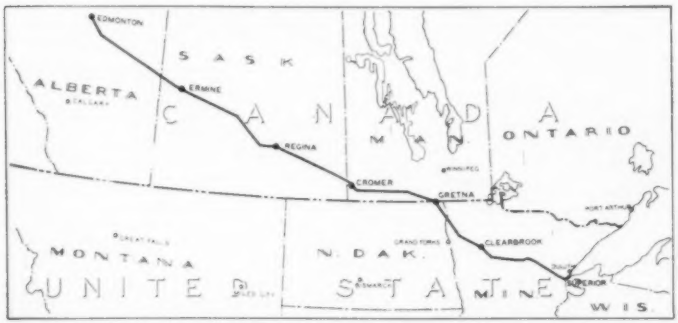
The type of country to be traversed and characteristics of the crude oils to be handled presented no unusual problems for the designers, but a great deal of attention and study had to be given to the effects of the widely changing weather temperatures. Air temperatures below freezing prevail in western Canada for 8 months of the year, reaching as low as 57° below zero and during the dry summer the thermometer frequently climbs past the 100° mark. Such widely fluctuating temperatures, if transmitted to the oil being pumped, would present impractical operating problems, so efforts are being made to prevent the viscosity from rising very far above that existing at the production batteries after oil has been heated for water and b.s. removal.

A study of soil temperatures at various depths which was made by University of Saskatchewan in 1926 reveals that whereas frost penetrates to a depth of 6 ft., the minimum temperature recorded at 3 ft. was 25°. At this depth the maximum summer temperature was 52°. It was decided to bury the pipe line with 3 ft. of cover, which will provide sufficient weight against frost heaving in springtime, and at the same time prevent the oil from getting cooler than approximately 30° F. Hydraulic design was based on viscosities of the crudes to be pumped at this temperature.

Another effect of the Canadian seasons is to shorten the construction period. Due to late breakup of frost (May) and early fall rains and freezing (October), pipe-line construction work must be confined to the intervening 5 months. This feature means that more construction equipment must be utilized than would ordinarily be the case, and due to the contemplated rapid construction of the line, work on the pumping stations is being commenced well in advance of the pipe laying.

The pipe line will be constructed initially with six pumping stations, three of which are situated in locations isolated from highways, railways, towns, and power or water supply. These stations are therefore being constructed with airstrips to accommodate company-owned aircraft which can land in summer on wheels and in winter on skids to service the stations with maintenance personnel, tools, and supplies. Complete housing and recreational facilities will be provided for operating staffs at such locations, and the company anticipates clearing snow from secondary roads and transporting the employes' children to the nearest schools.

The extremely long and cold winter season has its effect on pumping equipment design, too. Whereas conventional engine-water cooling systems usually take the water outside of the pump house to heat exchangers or cooling ponds, Interprovincial's engineers have provided for all of this equipment within the building due to difficulties anticipated from rapid freezing of inactive water circuits unless promptly and thoroughly



Map showing route of the proposed crude-oil pipe line

Whitney G. Sexton, mechanical engineer, is a native of Canada who is now a naturalized United States citizen. He graduated in 1927 from Nova Scotia Technical College in mechanical engineering and from Massachusetts Institute of Technology in engineering administration in 1929 and immediately joined the engineering staff of Imperial Oil, Ltd., at its Sarnia refinery. In 1935 he transferred to Imperial Pipe Line Co., Ltd., to do valuation work, and has been associated with all phases of pipe-line engineering, construction, and operation since that time. In 1947 he was sent to Edmonton, Canada, to construct and operate pipe lines for handling crude oil and has recently been engaged in engineering planning for the big-inch line to the Great Lakes. Sexton spent 3 years during World War II as a fuel officer in the U. S. Navy.

tical installation of heat exchangers to conserve space and facilitate removal of tubes by overhead crane; also location of engine fuel tanks and equipment in pressurized and heated room

drained. Fuel-oil tanks, jacketed exhaust mufflers, and engine air filters are also placed within the building, and provision has been made for heating of engine intake air in extremely cold weather by utilizing heat from engine exhaust gases.

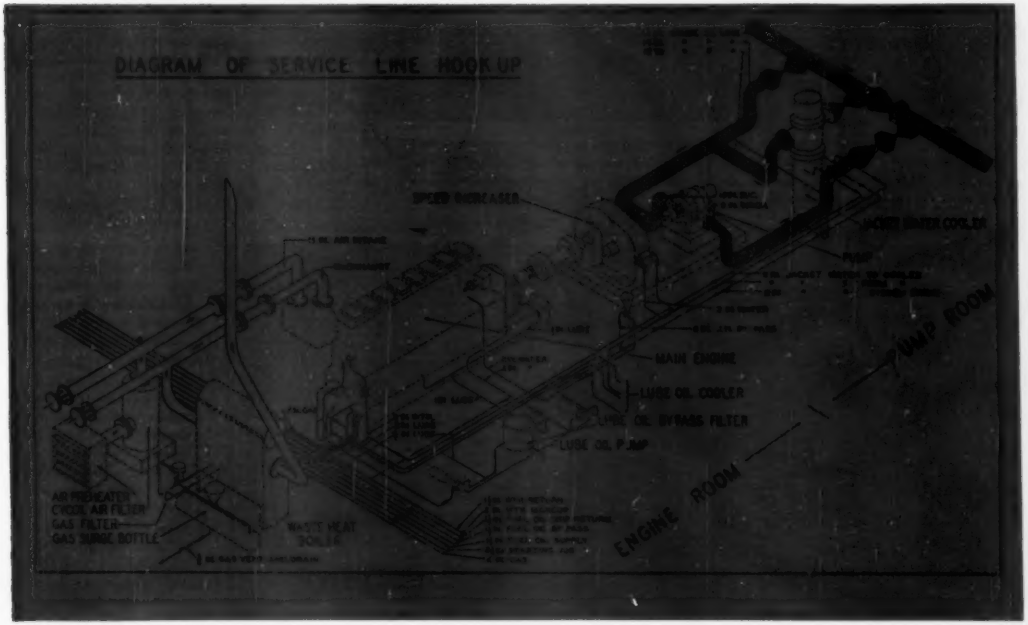
Typical pumping stations have been designed to develop a line pressure of 1,050 psi. by employing three single-stage centrifugal pumps connected in series. These pumps will be driven through 6:1 speed increasers by 1,080-hp. 600-r.p.m. turbocharged diesel engines which will be indirectly cooled by the crude oil passing through the station in closed-system heat exchangers. The entire pipe line will operate as a closed system, with pumping stations synchronized by automatic controls on the variable-speed prime movers. This system will provide flexibility for efficient pumping at varying throughputs and rates of delivery at intermediate takeoff points.

All of the main power and pumping equipment is being built in Canadian plants, and it is felt that this job will aid Canadian equipment manufacturers in development of the techniques which are peculiar to production of the types of equipment used in Canada's rapidly growing oil-field and pipe-line industries.

A rather interesting and somewhat perplexing construction problem must be solved in laying the pipe line

(Continued on page 239)

Diagrammatic sketch of one complete pumping unit, showing oil, air, exhaust and water piping. Note preheater for engine intake air in wall plenum and exhaust piped to boiler to generate steam for heating



H. M. Dreyer, Jr., chief dispatcher, Plantation Pipe Line Co., received his education at University of South Carolina and the Georgia School of Technology. After several years' experience in civil engineering, he joined Plantation in 1942. Shortly thereafter, he became a dispatcher, and in 1946, he was promoted to senior engineer; in this position he was concerned with general engineering and economic studies. He returned to the operations department on January 1, 1947, in the position which he presently holds.

Scheduling

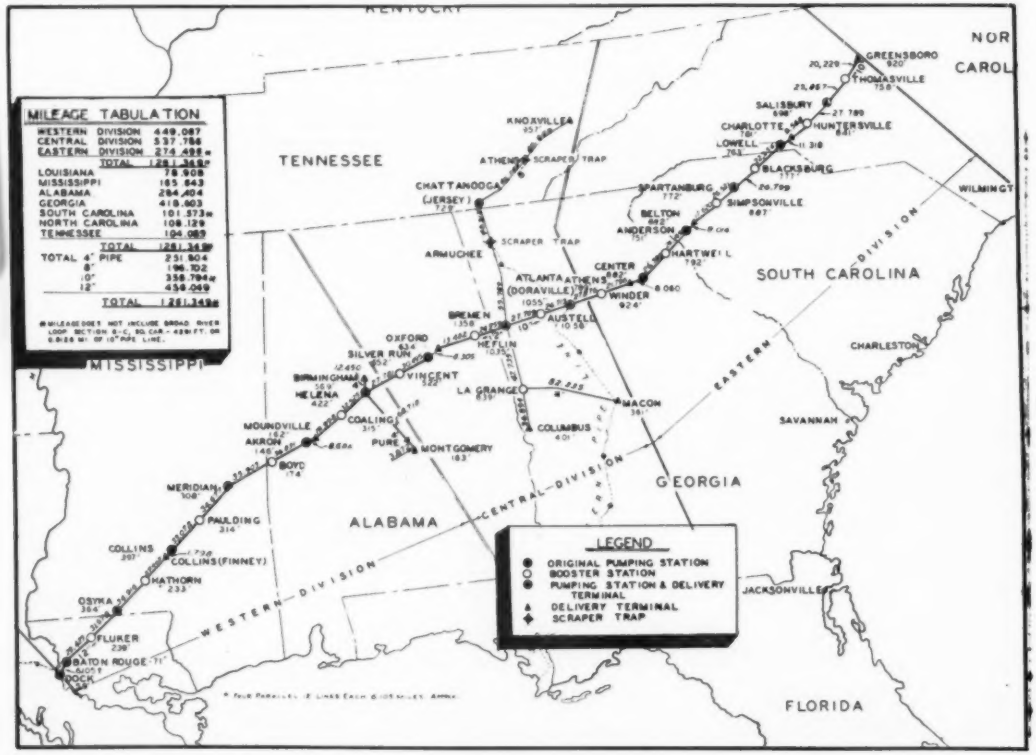
DESCRIPTION OF THE

by H. M. Dreyer

THE problem of devising satisfactory methods for the control of the movement of a multiplicity of products through a connecting series of pipe lines of varying pumping capacities presents many difficulties to the designer of a pipe-line operating system. Initially, the method selected must be extremely flexible in order that changes produced by the variations of supply and demand may be accommodated with a minimum of work duplication by the scheduling and dispatching personnel. It must be sufficiently expansive to permit the scheduling of each line in the system as an individual unit, yet it must be sufficiently coherent to embrace the movement of all lines in the system as a whole, since the movement of products through any one line in the system directly affects the movement through every other line in the system unless unlimited intermediate tankage can be provided.

The method must be one which will allow for easy selection of the most efficient means of utilizing the available capacity, since inept use of facilities could result in losses of capacity to the system of as much as 20 per cent. It must be as nearly errorproof as possible, yet it must not be allowed to become so complicated that it is topheavy and requires more time and effort in preparation than

Fig. 1—The Plantation Pipe Line system extends across seven southern states and serves an area which is roughly 10 per cent of the United States. Much of its tributary area has become heavily industrialized. From its initial elevation of 46 ft. to its peak elevation of approximately 1,400 ft. and down again to its terminus in North Carolina at an elevation of 920 ft., it traverses a wide variety of topography. The Bayou Pipe Line system acts as a feeder line for Plantation for products refined in the Texas Gulf area



and Dispatching

PROCEDURES AT PLANTATION PIPE LINE

in the actual application of the methods to operation of the pipe-line system itself.

Lastly, the method must be comparatively simple on the lowest level of operation in order that clear pictures of the operating problems may be instantly apparent, the transmittal of information may be quick and concise, and solutions to problems rapidly and accurately developed at the time of their presentation.

The scheduling and dispatching functions are each an intregal part of the other, but in the selection of methods for their performance, they must be considered as separate functions since methods which might be ideal in application to the one might not fit the needs of the other. Such was found to be the case with the Plantation Pipe Line system.

Description of Line

Plantation Pipe Line Co. operates a system which is 1,261 miles in length. A 12-in. main line extends 456 miles from Baton Rouge, La., to Bremen, Ga., and a 10-in. main line extends 357 miles from Bremen to Greensboro, N. C. The remainder of the system is composed of an 8-in. lateral line from Helena, Ala., to Birmingham, Ala., a 4-in. lateral line from Helena to Montgomery, Ala., an 8-in. lateral line from Bermen to Chattanooga and Knoxville, and a 4-in. lateral line from Bremen to Macon and Columbus, Ga. (See Fig. 1).

The line is powered by 31 pumping stations and there are 19 delivery terminals along the system. Products are received into source point tankage through a dock station located at Baton Rouge and through a tiein with the Southeastern Pipe Line at Doraville, Ga. At Baton Rouge, products are received from the Bayou Pipe Line, which acts as a gathering system for Plantation, from the Esso Standard Oil Co. refinery located at that point, and by barge and tanker.

Three tank farms with a total capacity of approximately 2,698,000 bbl. are provided along the system. The greatest proportion of tankage is located at the initial receiving point at Baton Rouge, and the remainder is distributed between tank farms at Helena, Ala., and Bremen, Ga. These stations are source points for lateral lines, and, in the case of Bremen, a point at which main line size is reduced.[1]

Each station on the 12-in. line is equipped with two 900-hp., explosion-resisting motors directly coupled to three-stage, 3,600-r.p.m. centrifugal pumps which are connected in series. The 10-in. line is similarly equipped with the exception that the motors are 600 hp. and the pumps are four stage. Electric power is used exclusively to provide the energy for the operation of the pumping stations.[2]

Although the system was designed for a maximum throughput of 90,000 bbl. per day of gasoline with all of

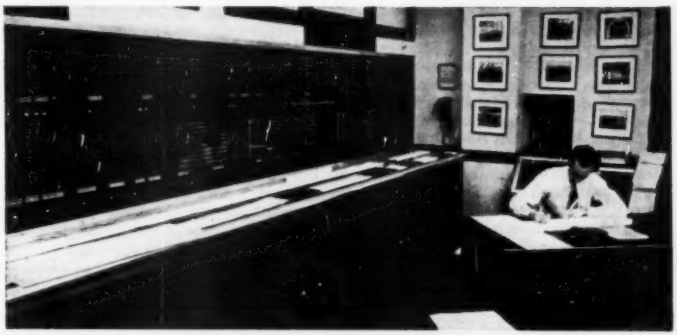


Fig. 3—A longitudinal view of the dispatching board showing the working position of the dispatcher in relation to the board. The profile etched into the ruled plastic is picked out in red and it does not show up well in this picture. Sheets of light green felt have now been inserted behind the plastic for additional contrast

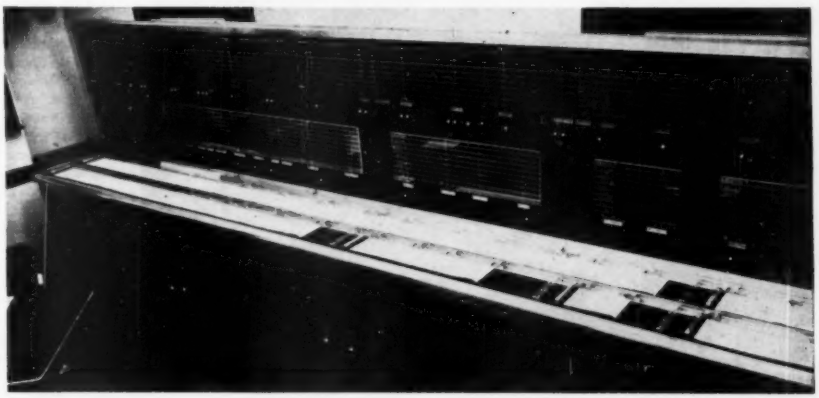


Fig. 2—A view of the dispatching board looking down at the table surface. A weighted door at the source point of each line holds the tape in position and affords an entry point from the body of the board for the tape. Colored indicating lights for pumping units, delivery terminal valves, sump pumps, etc., and name plates are provided beneath the proper points on the profile which is etched on the ruled sheets of plastic on backboard. Work tables and teletypes are at either end of board

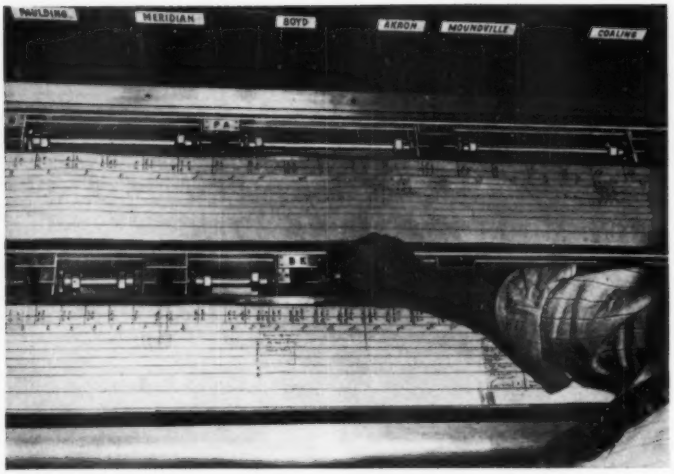


Fig. 4—A closeup of the calibration mechanism. The dispatcher is calibrating by means of a vernier for mean average pressure in the section from Blacksburg, S. C. (BK) to Charlotte, N. C. (CT). He will also calibrate for mean average temperature by means of a vernier located on the upstream (opposite) side of the Charlotte marker. A scale representing the pipe-line fill at 60° F. is inset into the face of the board just in front of the markers. The clear plastic covers which are normally in place over the calibration mechanism and station markers have been removed for this picture to reduce light reflection

the booster stations operating, careful and efficient use of the facilities has made possible the maintenance of daily averages in excess of 94,500 bbl. Approximately 7,000 bbl. per day which is received through the Doraville tiein with the Southeastern Pipe Line is not included in these averages.

It is now estimated that receipts from Southeastern will increase to approximately 12,000 bbl. per day to raise the total input average for the system to approximately 106,500 bbl. per day. It is significant that these averages have been obtained in spite of the fact that the percentage of the heavier fuels (kerosines, tractor fuels, and diesel fuels) has increased from approximately 7 per cent at the start of operations in 1942 to approximately 24 per cent in 1948. The obtaining of such averages is reflective of top efficiency in the scheduling and dispatching functions.

Scheduling of Products

At the present time, 31 products owned by 11 shippers are moved through the system and delivered into tankage owned by the shippers at the 19 delivery terminals. Absolute segregation is maintained for all products except kerosine, which is a common product. In November 1947 the total of the quantities of products offered for movement exceeded the possible capacity of the line, and since that time it has been necessary to allocate the capacity of the line among the various shippers.

On first approaching the problem of selecting the most suitable method for the scheduling procedure, it would seem that a graphical solution would best fit the circumstances. Closer consideration, however, determines that the disadvantages of graphical methods far outweigh their advantages. Since the scheduling of six integrated pipe lines with widely divergent pumping capacities is the problem, a graphic system would become too complex for ready manipulation or interpretation.

Graphical solutions lack the fine degree of accuracy and the extreme flexibility which is desired, and they are subject to inherent possibilities of error in both plotting and interpretation. In any such system adopted, it would be necessary to first calculate and then plot the points forming the graphs. In a system which contains numerous delivery points, such a method inevitably becomes hopelessly involved. The graphical solution, therefore, was rejected as being too cumbersome for the type of operation which was desired at Plantation.

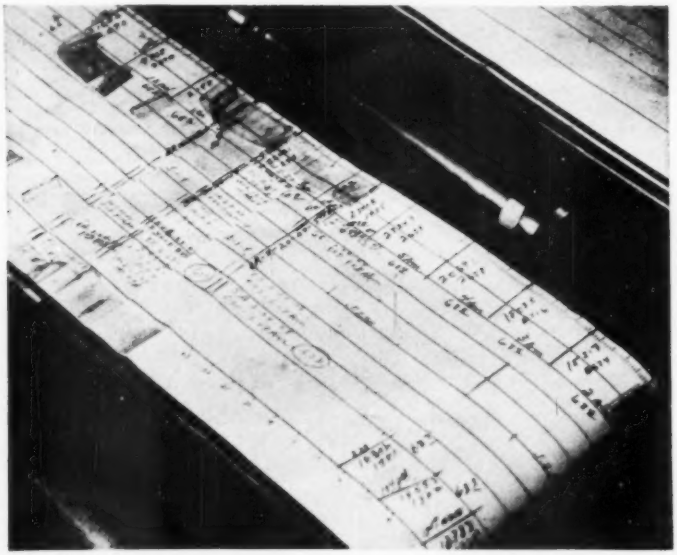


Fig. 5—A section of stream tape near the Greensboro terminal marker (terminus of the 10-in. line). The lower edges of the tapes are banded with colors indicating the grade of product represented and its owner. The upper edge of the tape is scaled to 2,000 bbl. per inch. The notations just below the scale indicate the accumulative total for the batch, the hourly source point pumping by meters, and the average A.P.I. gravity for each hour. The tapes which are attached with gummed tape are points at which the tape for a batch was cut and lapped over by the metered delivery quantity each hour at some terminal to which delivery was made from the batch. The series of short parallel lines running vertically across the face of the tape at batch heads are the plotted batch changes. The marks represent first and last gravity changes and the distance between them is the commingled quantity. The slanted lines at the right in the lower third of the tape represent the difference in barrels actually metered out at the terminus point of the line in comparison to what should have been metered out in accordance with tape movement. It actually represents a collection of small, uncontrollable accuracies plus the overage or shortage for the batch. As long as the slope of this line remains fairly constant, no error has been made, nor is there a leak in the pipe line

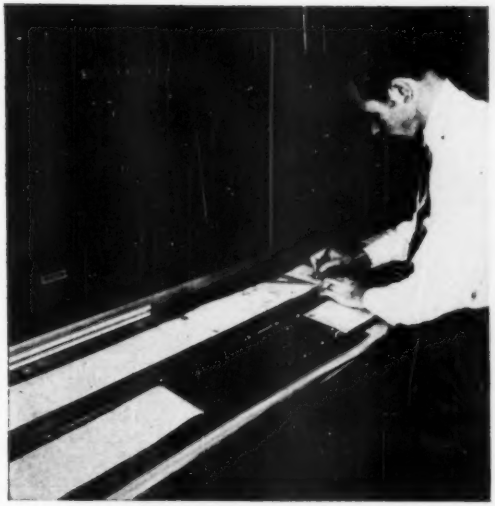


Fig. 6—(Left) Dispatcher posting the stream tapes on the dispatching board. The tapes are moved forward each hour by the metered input barrels. Batches in transit are reduced by the quantities delivered out of them through a process of lapping over in the body of the tape for the batch by the amount metered out at delivery points. The tape for quantity which leaves each line at its terminus point enters the lower part of the board through slots in the surface. Fig. 7—(Right) One of the two switchboards for control of the dispatching board indicating light system. The dispatcher may operate the toggle switches on its face without leaving his position at the teletype. The duplicate set of lights on the switchboard are connected in parallel with those on the dispatching board

The other alternative is a system of additive calculations based on speed of movement as opposed to delivery requirements. This method is utilized at Plantation in the manner outlined in succeeding paragraphs.

On the tenth day of each month, Plantation notifies each shipper of the amount of space which will be available in both the 12 and the 10-in. lines for the next succeeding month. These quantities vary from month to month according to the numbers of days in the month and the percentage of the heavier fuels which are currently being handled. During the 10-day period prior to the twentieth of the month, the various shippers advise Plantation of the total quantities of each grade of product which they intend to offer for movement during the succeeding month, the approximate time that they desire their products to enter the pipe line, and the approximate distribution.

Since the capacity of the Plantation system is allocated, this information is very carefully reviewed by the dispatching department to determine if there have been any cases of over or underscheduling. Shippers who have overscheduled are advised that they must reduce their offerings to conform to their allocations, and any unutilized space is offered to the various shippers on a percentage basis.

When all of this information is in such condition that it is possible to determine the total of each type of product that is to be transported during the period, a tentative pumping schedule covering the operations for the entire month is drawn up, setting forth the products in repetitive cycles.

Theoretically, each cycle consumes 5 days of pumping time, and is made up of an indeterminate number of batches of a 25,000-bbl. minimum size. There are several factors which must be taken into consideration in batching and cycling of products. The total number of cycles is determined by the necessary number of fuel cycles which will satisfy the needs of the shippers. At the present time, two fuel cycles per month are being pumped. Several gasoline cycles enter the line immediately ahead of each fuel cycle.

From each of the gasoline cycles the shipper draws, not only enough gasoline of each grade from his batches to meet his requirements until the arrival of the next gasoline cycle, but a reserve supply in excess of his needs. Repeating this procedure through each of the gasoline cycles preceding a fuel cycle, the shipper accumulates a sufficient reserve supply of gasoline to satisfy his needs during the period that fuels are being pumped past his terminal points. As the fuel cycle passes, he draws sufficient fuels from his batches to meet his needs until the next fuel cycle shall arrive.

Positioning of batches in cycles is controlled by the specifications of the products. Those products which are of a higher grade or which have specifications which preclude any commingling are placed in the center of the cycle in order that the lower grades of products may act successively as buffers for them and for each other. The arranging of products in this manner eliminates the possibility of degradation of product by commingling to a point where the product would be below salable quality. Close attention is given to this factor in Plantation operations.[a]

Positioning of the batches is also affected by the requested distribution of the product. All batches enter the line as nearly as possible at the time specified by the shipper. Entry time may vary somewhat, of course, as additions or reductions to preceding batches take place in response to variations of supply and demand. Arrival times at various terminal points may also undergo drastic changes as distribution revisions to succeeding batches take place.

When the pumping schedule has been completed and circulated among the shippers, delivery schedules are compiled on a daily basis. Although it is a matter of necessity that delivery schedules be compiled sufficiently in advance that the shipper may be given 24 to 48 hours' advance notice of deliveries at each point in order that certain state inspection requirements may be fulfilled, it is a matter of efficiency of operation that these schedules be calculated for periods of 2 weeks or more in advance.

Several of the factors which affect the positioning of the batches also must be considered in the compilation of delivery schedules. A certain increase in throughput is obtained while stripping deliveries are in

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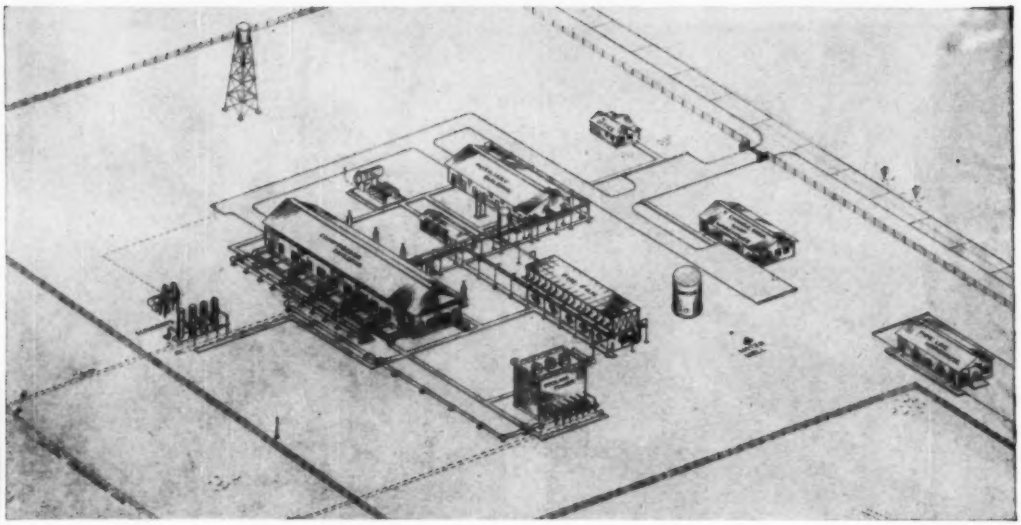


Typical compressor station designed for the Transcontinental system

Design and Construction of

Transcontinental's System—Largest Artery of the Natural-Gas Industry

by R. D. Ricketts

TRANSCONTINENTAL GAS PIPE LINE CORP. filed an application early in 1949 with the Federal Power Commission for a certificate of convenience and necessity to construct and operate a natural-gas transmission system. The certificate, as applied for, contemplated the installation of facilities which would transport Texas gas to the Eastern Seaboard area of the United States and would follow a route generally along the Gulf Coastal plains and Atlantic Seaboard plains. Actual hearing of the application by the commission began in October 1947, and was successfully completed in May 1948. The hearings lasted slightly more than 8 months, resulted in excess of 9,000 pages of testimony, and in numerous exhibits being presented to the commission.

The certificate, issued on May 29, 1948, was contingent upon the ability of the company to secure a satisfactory and reliable source of steel plate and a satisfactory and reliable source of fabrication of such plate into pipe, these being extremely scarce and difficult items to obtain in the immediate postwar years. A further contingency of the certificate as issued by FPC was satisfactory financing of the entire project. Financing arrangements were contingent upon securing the source of steel plate and its fabrication into pipe. A contract for steel plate with the Kaiser Co. and a contract for the fabrication of the plate into pipe with Consolidated - Western Steel Corp. were satisfactorily concluded in August 1948. Financing arrangements were concluded immediately following the signing of the above contracts, and a further hearing was held by FPC in October 1948. At the end of this hearing, the certificate of convenience and necessity was finalized and made firm by the commission and specified that the facilities must be constructed and in operation by April 1951.

On December 7, 1948, Transcontinental entered into a contract with Fish Engineering Corp. for the design, engineering, and construction of the project. Fish Engineering, through its affiliate, Fish Constructors, Inc., immediately augmented its existing staff to perform under the contract. Staff heads were set up for land and right-of-way departments, comptroller and accounting, construction and physical facilities, including all pipe lines, compressor stations and dehydration plants, gas measurement and cathodic protection and communications, engineering department, purchasing department, personnel department, and other necessary staff divisions. Active work on the project was initiated after the execution of the contract.

The schedule of construction and the completion of the project is to a major extent controlled by the delivery of main-line pipe, and it is hoped to complete the project ready for preliminary operation during the mid-fall of 1950.

On account of the distance involved, the magnitude of the project, and the rate of construction being controlled by the delivery of pipe, it was decided to divide the work to be done into two construction periods, the 1949 phase and the 1950 phase, with all efforts initially being applied to the work to be performed

Richard D. Ricketts is vice president of Fish Engineering Corp., and Fish Constructors, Inc., and a partner of both of these companies. He is in direct charge of the work being done by Fish Constructors on the engineering and construction of the Transcontinental Pipe Line system. Ricketts is a graduate engineer of Ohio State University and is a registered professional engineer, in the states of Ohio and Texas. Prior to the time when he and his associates formed Fish Engineering Corp., in 1946, he was for 7 years with Stearns-Roger Manufacturing Co., on the engineering and construction of all types of processing plants and compressor stations for the gas and oil industry. After graduation from Ohio State University, Ricketts went with Columbia Gas & Electric System for 9 years in design and engineering, as well as in the operation and maintenance of compressor stations, gas pipe-line systems, gasoline plants, etc. From Columbia, Ricketts went with Panhandle Eastern Pipe Line Corp. and participated in the expansion program of that company during 1936 and 1937.

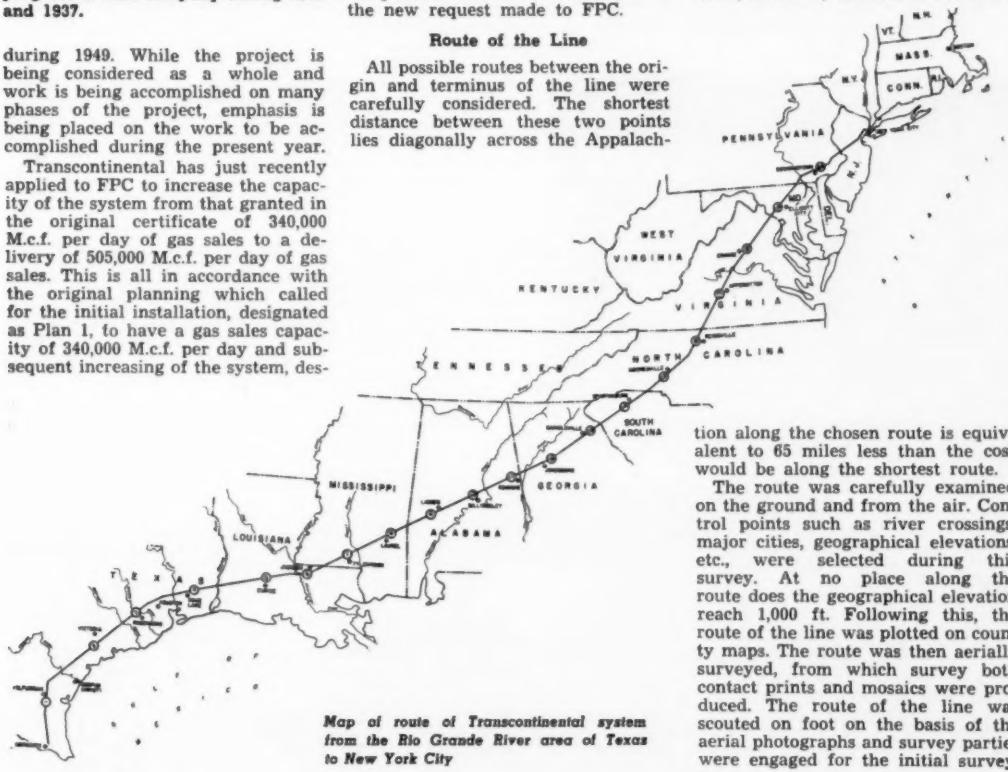
Boom tractors with pipe gang laying 30-in. pipe for Transcontinental in Mississippi

during 1949. While the project is being considered as a whole and work is being accomplished on many phases of the project, emphasis is being placed on the work to be accomplished during the present year.

Transcontinental has just recently applied to FPC to increase the capacity of the system from that granted in the original certificate of 340,000 M.c.f. per day of gas sales to a delivery of 505,000 M.c.f. per day of gas sales. This is all in accordance with the original planning which called for the initial installation, designated as Plan 1, to have a gas sales capacity of 340,000 M.c.f. per day and subsequent increasing of the system, designated as Plan 2, to have a gas sales capacity of 505,000 M.c.f. per day by adding additional compressor stations and increasing the size of the mainline pipe between a point near Markham, Tex., and Eunice, La. While the work now being performed on the system during the 1949 program is in accordance with the certificate, it is contemplated that the system when completed will be in accordance with the new request made to FPC.

Route of the Line

All possible routes between the origin and terminus of the line were carefully considered. The shortest distance between these two points lies diagonally across the Appalachian Mountain range, the plains and lowlands of Mississippi and Louisiana, across a small portion of the Gulf of Mexico, and across the southern tip of Texas to a point near McAllen. The line is approximately 1,840 miles in length and traverses the coastal plain throughout the entire route. It is approximately 100 miles longer than the shortest possible route; however, the cost of construction along the chosen route is equivalent to 65 miles less than the cost would be along the shortest route.



Map of route of Transcontinental system from the Rio Grande River area of Texas to New York City

The route was carefully examined on the ground and from the air. Control points such as river crossings, major cities, geographical elevations, etc., were selected during this survey. At no place along the route does the geographical elevation reach 1,000 ft. Following this, the route of the line was plotted on county maps. The route was then aerially surveyed, from which survey both contact prints and mosaics were produced. The route of the line was scouted on foot on the basis of the aerial photographs and survey parties were engaged for the initial survey.

The results of the field survey have been placed on alignment sheets for right-of-way purchase and actual construction work.

The route, as finally selected, crosses 12 states, 109 counties and parishes, 55 major rivers and streams, 110 railroads, and 619 state and federal highways.

Design

The system is designed to transport for sale approximately 505,000,000 standard cubic feet of gas per day. Pipe-line calculations are based on the so-called Panhandle Eastern Pipe Line formula. A flow efficiency of 96 per cent was assumed for 30-in. pipe line. and 95 per cent for 26-in. pipe line. Basic calculations are based on average yearly load factor of 95 per cent. Gas-purchase contracts specify minimum heating value of 1,000 B.t.u. per cu. ft. and flow calculations are based on a pressure base of 14.73 psi. at 60° F. flowing temperature and the gas having a specific gravity of 0.6. Adjustments are made for supercompressibility on all metered gas. Producers have the privilege of extracting all liquid products and delivering to the pipe line residue gas, at a central point within the field, having a heating value of not less than 1,000 B.t.u. per cu. ft.

The design contemplates the use of the following lengths and diameters of main-line pipe:

1,569	miles	of	30-in. pipe
5	miles	of	26-in. pipe
192	miles	of	24-in. pipe
26	miles	of	20-in. pipe
43.5	miles	of	14-in. pipe
35	miles	of	10-in. pipe
1,870.5	miles	of	main-line pipe

The maximum operating pressure of the main line is 800 psig. In addition to the main-line pipe, the following pipe will be installed to serve as gas-supply lateral lines and gas-sales lateral lines:

381	miles	of	gas-supply lateral lines
107	miles	of	gas-sales lateral lines

The contract for the pipe is divided into two basic parts, steel plate and fabrication. The plate is being furnished by Kaiser Co. from its Fontana mill. The Kaiser plate is being fabricated into pipe by Consolidated Western Steel Co. at its plant in Maywood, Calif. The plate specifications are based on chemical analysis satisfactory for the fabrication of the plate into pipe. The pipe specifications require internal sizing, or stretching, of the pipe, which increases the yield point of the basic steel to a minimum of 52,000 psi. Transverse yields on pipe received to date have been appreciably over the minimum required.

The 30-in. main line is being installed as a telescopic line. Pipe-wall thickness for a minimum distance on the discharge of each compressor station is designed at .325 in. The remainder of the distance between compressor stations is designed at a wall thickness of .3125 in. This has resulted in an appreciable saving to the project. All railroads, highways, and compressor station yards are crossed by pipe having a wall thickness of .375 in. All highways and railroads are cased with ¼ by 34-in. o.d. casing, properly sealed and vented.

At the present time, the pipe is being transported by rail from the point of fabrication in California to locations along the pipe-line right-of-way. The water transportation of the pipe by boat was thoroughly considered and investigated but proved uneconomical because of the space required in comparison with the weight involved. In other words, the tariff for such is calculated by volume rather than by weight. Proposals have recently been received and are now under consideration for the rafting of the pipe whereby the pipe rafts would be towed by tugs from the West Coast through the Panama Canal to ports adjacent to the right-of-way where the raft would be disassembled and the pipe hauled to the right-of-way.

Main-line valves will be installed at approximately 16-mile intervals. Each valve setting will consist of a main block valve and two 8-in. blow-down valves. All valves are designed

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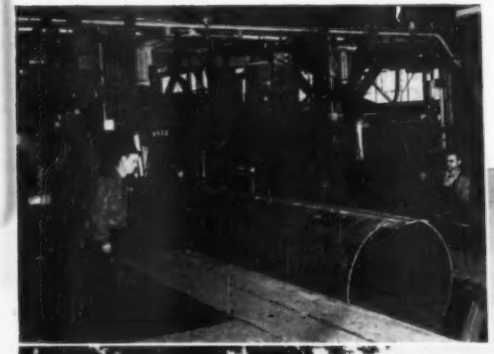
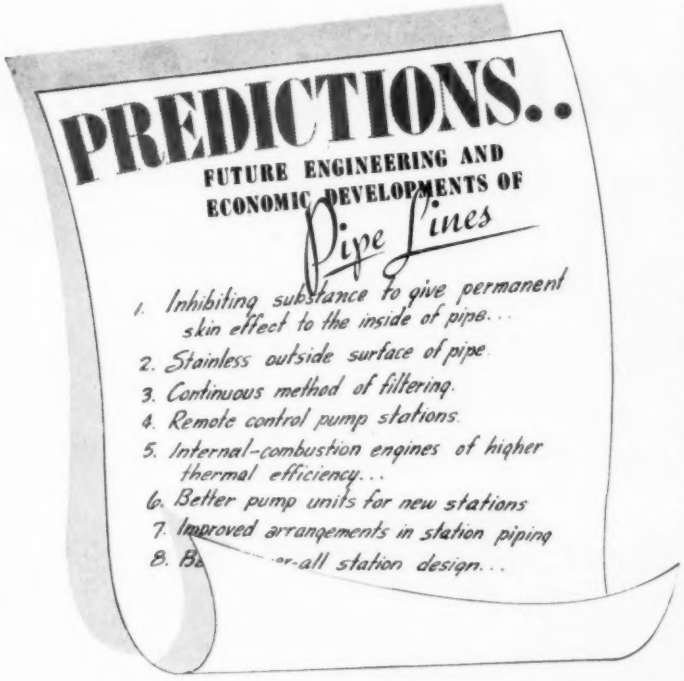


Left: Pipe mill of Consolidated Western Steel Co., Los Angeles, making 31-ft., 6-in. joints for Transcontinental. Below: Double-jointing operation whereby two joints are welded by automatic welding process to form a 63-ft. joint for delivery by stringing truck to the right-of-way


PREDICTIONS..
FUTURE ENGINEERING AND
ECONOMIC DEVELOPMENTS OF
Pipe Lines
1. Inhibiting substance to give permanent skin effect to the inside of pipe...
2. Stainless outside surface of pipe.
3. Continuous method of filtering.
4. Remote control pump stations.
5. Internal-combustion engines of higher thermal efficiency...
6. Better pump units for new stations
7. Improved arrangements in station piping
8. Be ...er-all station design...

by W. R. Finney

THE remarkable and dependable performance of pipe lines during the last war, under the most difficult and hazardous conditions, finally convinced many people in all walks of life that pipe lines provide safe and satisfactory transportation for petroleum and its products. This fact had been known by oil men for a long time, but it took something as spectacular and convincing as the gasoline lines to the fighting fronts to win public favor for this form of transportation. Pipe lines well deserve this recognition, and the companies have continued to conduct their business along sound economic lines so as to merit the support of the consumers of petroleum products.

There are many reasons why pipe lines as built and operated today, to transport crude and refined products, should continue to furnish efficient service at a reasonable cost even after provision for depreciation, income tax, and interest on the investment. For example, a welded steel pipe line can be built on level land or through mountains, across rivers and under lakes with little inconvenience or risk to the owner or the people living in the area. This is accomplished by welding the individual joints of pipe in one continuous steel tube which may extend for several thousand miles. Even today the pipe lines from Texas to the East Coast, and westward to the Pacific, could be connected to form one continuous system close to 3,000 miles long.

Pipe lines cover the central part of the United States, and new ones are now being built in Canada and the Middle East. In this connection, it is well to point out that even the large-diameter line, made of the finest steel for high operating pressures, with wide station spacing, cannot compete with the huge ocean-going tankers on a cost per ton mile basis. However, the pipe line laid directly across the country will show a lower cost per barrel than the tanker which is forced to take the longer sea route. For example, a large-diameter crude-oil line was recently finished in Venezuela, and another one is being rushed to completion to move oil from the Persian Gulf to the Mediterranean.

Modern Developments

The modern way of building pipe lines has been developed over a long period of years, and provides for welding the joints so they are as strong as the steel itself. The entire line is guarded against corrosion by the cathodic method, or through the application of a protective coating. The line is then buried several feet below the surface, so it is out of the way, and the oil moves so quietly that even those walking across the right-of-way or farming the land do not know the pipe line is there. There are some places along the route of a new line where the hardest of rock makes the ditching work very expensive, and some of the leading engineers in the pipe-line fraternity have developed the restrained type of construction. This calls for laying the pipe aboveground, and holding it in place with steel bands anchored to concrete footings.

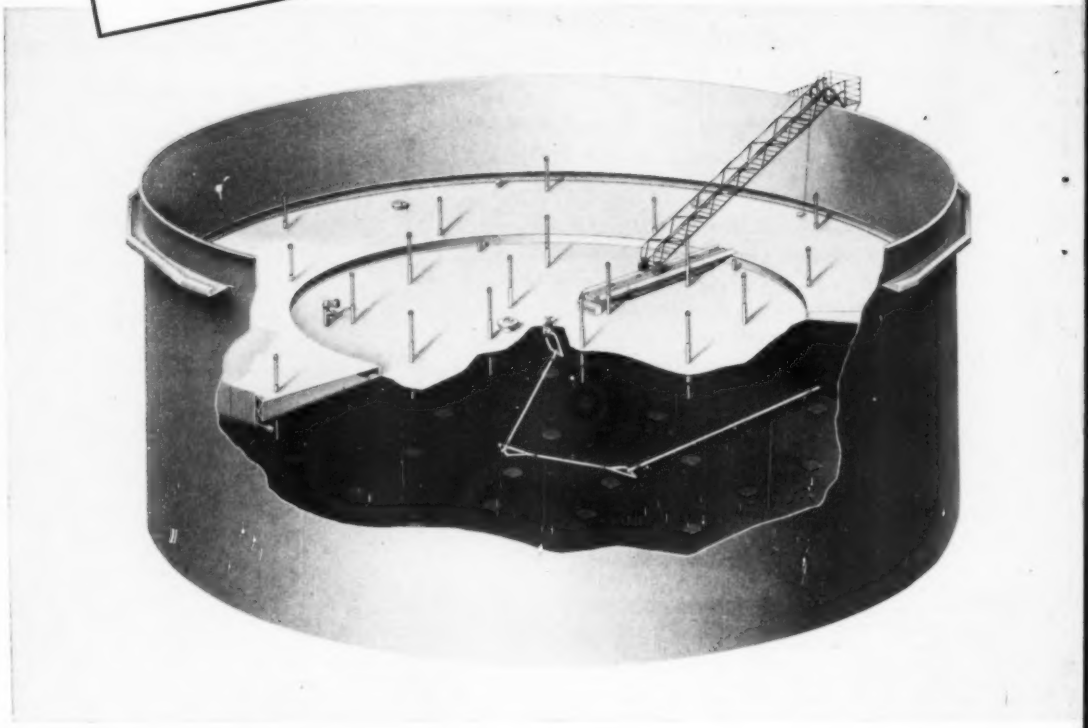
In a similar way, this type of construction can be used across marshes, where piles driven deep into the ground can serve as supports for the restrained line. Likewise, steel bridges or cableways can be used to cross deep or treacherous streams, and pipe lines have been laid through the roughest of mountains by anchoring the pipe to the face of the cliffs. All of this proves that pipe lines can be built and operated under the most difficult conditions

(Continued on page 319)

The Author

Wallace R. Finney, pipe-line adviser to Standard Oil Co. (N. J.), graduated from Stanford University in mechanical engineering in 1912. After field work and engineering in California and Oklahoma, he started 11 years' service with Midwest Refining Co. in Wyoming. In 1929 he supervised Lago's Lake Maracaibo, Venezuela, electrification. When Pan American Petroleum & Transport foreign properties were acquired by Jersey Standard, he was transferred to handle Jersey foreign engineering work. In 1936 Finney became president of Oklahoma Pipe Line Co., and vice president of Ajax Pipe Line Corp. In 1939 he returned to New York to coordinate Jersey's domestic pipeline operations. He was president of Portland Pipe Line Co. in 1941. As Plantation Pipe Line Co. director, he conducted entire system planning. In 1943 Finney became director in natural-gas pipe-line companies in which Jersey had an interest. In 1944 he became pipe-line adviser. He is now vice president, Interstate Natural Gas Co., director, Plantation Pipe Line Co. and Interstate Oil Pipe Line Co., and alternate director, Middle East Pipelines, Ltd., assisting with planning Middle East, Iraq, and Trans-Arabian projects. During the war, Finney was chairman of committee which supervised "Big-Inch" and "Little Big Inch" projects.

THREE TYPES of Floating Roofs



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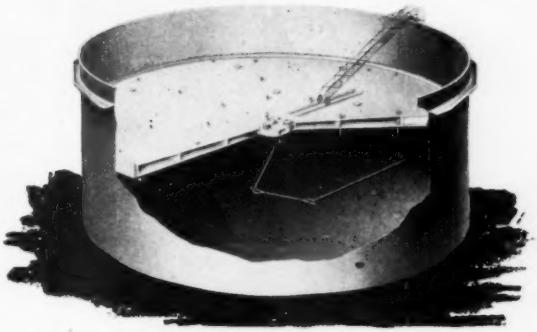

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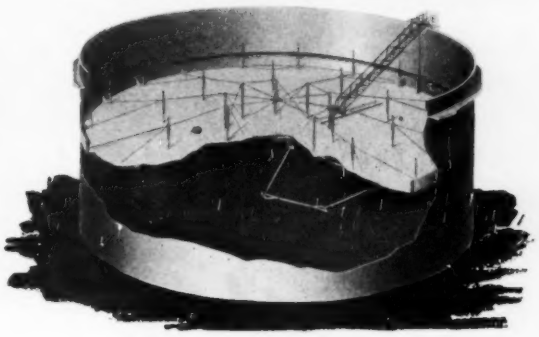

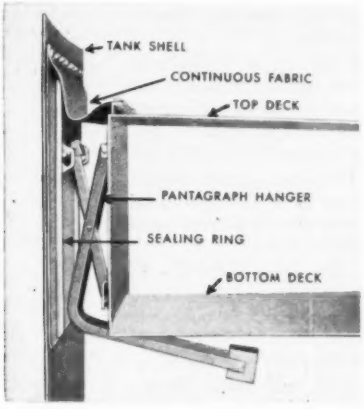

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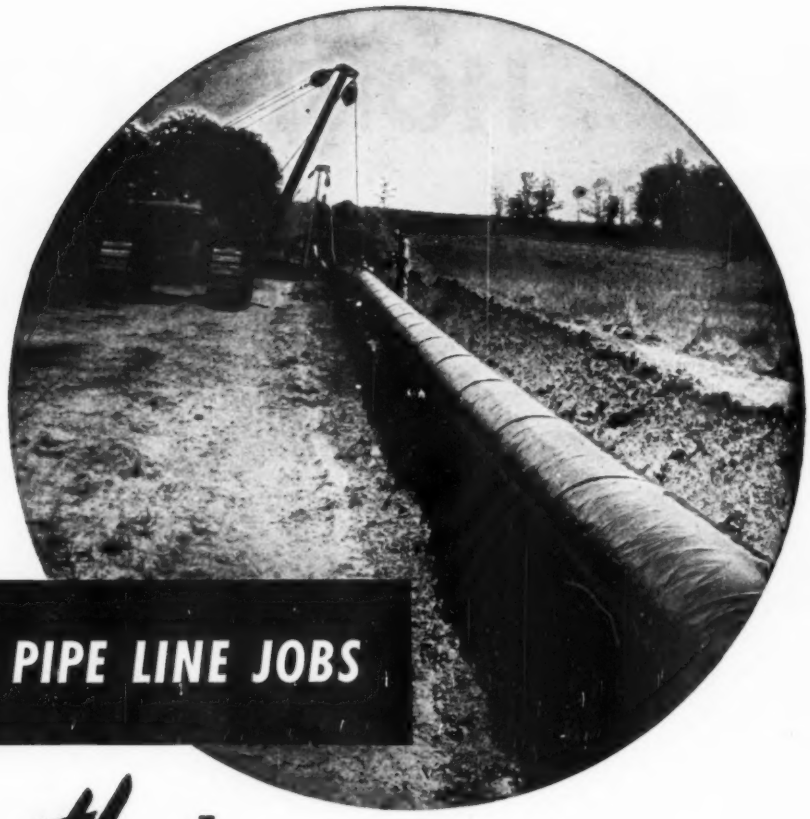

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The Roughness Problem

With respect to flow through commercial steel pipe and the direct solution of the Fanning equation for either the flow rate or diameter

by Oscar Wolfe

THE advent of large-diameter pipe in the construction of oil and gas pipe lines in the United States and the heavy capital outlay necessary in these days to create such a system places the pipe-line engineer in the position where, more than ever, he must be able accurately to predict the probable throughput capacity for a contemplated project. If all of the elements of the problem are correctly taken into account according to well-established methods, the accuracy of pipe-line flow calculations depends almost wholly on the choice of the correct friction factor in the basic Fanning equation.

Large-diameter oil and gas pipe lines of today are operated under conditions represented by high Reynolds numbers where the effect of "roughness" causes a marked deviation from the original Stanton and Pannell curve and, particularly, is this true for systems to be designed for the transmission of natural gas. It is the object of this paper to review this effect and to present for use by the practicing pipe-line engineer certain conclusions which have been developed during more recent years.

Shortly after the end of World War I, the experimental work on the flow of liquids and gases through smooth pipes by Stanton and Pannell at the National Physical Laboratory in London became available to American pipe-line engineers and, thus, paved the way toward a new and better technique for the design of oil and gas pipe lines. Before that day, the science of hydraulics, as applied to the transportation of oil and gas through pipes, depended largely on the use of coefficients which were chosen on the basis of experience alone and without a clear understanding of the relationship between the physical characteristics of the fluid passing through the pipe and the correct value of the coefficient.

As a matter of fact, Osborne Reynolds in England, long before that time (1883), had observed the basic fact that the flow of fluid through a conduit always proceeds according to one or the other of two regimes which are characterized as the streamline and the turbulent regimes of flow. By mathematical reasoning he, furthermore, derived the dimensionless criterion, since known as the Reynolds number which, by its magnitude, indicates first, whether the flow regime existing in a pipe is in the streamline or in the turbulent region and, secondly, establishes the critical range where the change from one into the other takes place. Nevertheless, the true significance of the Reynolds criterion escaped the hydraulicians of the day. It remained for the classical Stanton and Pannell experiments to bring to light the great value of the Reynolds number to the solution of practical flow problems, i.e., by establishing the functional link between the friction coefficient λ in the flow equation

$$h_f = \frac{\lambda L}{D} \frac{V^2}{2g}$$

and the physical characteristics of the liquid or gas which may be flowing through a pipe line. This relationship, now well known by all pipe-line engineers is:

$$r_o/\rho V^2 = \lambda/8 = \phi\,(DV\rho/\mu) = \phi\,(DV/\nu) \qquad (1)$$

as expressed by the Stanton and Pannell diagram.

In terms of consistent units in the gravitational or technical system of units, the symbols in this equation represent:

- r_o = fluid shearing stress at the pipe wall, lb./ft.^{2}
- ρ = unit mass of fluids, slugs, lb./g
- V = average or bulk velocity of the fluid, ft./sec.
- D = diameter of pipe, ft.
- μ = absolute viscosity, G-Rheyns. lb. sec./ft.^{2}
- λ = dimensionless friction factor.

Stanton and Pannell, be it noted, restricted their experiments to flow through smooth tubes of drawn brass and glass and, therefore, were able to show that the friction coefficient for

The Author

Oscar Wolfe, consultant for The Texas Co., New York, for more than 25 years, has been a leading authority in pipe-line design and the mathematical study of fluid flow. He has had an active part in engineering some of the most important domestic and foreign pipe-line projects. He has served as chief engineer of Texas Pipe Line Co. and was for a time chief engineer of The Texas Co., Houston. Wolfe was in charge of engineering (1937-39) for construction of the South American Gulf Oil Co. (Socony-Vacuum and Texas Co.) Barco line built 263 miles through the jungles of Colombia. During World War II he was chief engineer of War Emergencies Pipelines, Inc., construction and operation of the "Big-Inch" and "Little Big Inch" lines. He has also had an active part in the design of other important projects in South America and the Middle East.

This is the first installment of a three-part article. The remaining installments will be published in the issues of October 13 and October 20.

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all classes of fluids, be they liquid or gaseous, fall on to one single line divided into the laminar and turbulent regions at the critical range for $N_R \approx 2{,}500$ (±).

Similar experiments performed in the United States by Saph and Schoder and others on commercial steel pipes produced values for λ that were somewhat higher than the Stanton and Pannell results. It soon began to be surmised that the surface profile of the interior pipe wall and the ratio of the height of interior surface protuberances to the radius of the pipe gives rise, in the turbulent region, to a whole family of curves instead of just a single line as had been determined for smooth-wall tubing. With this in mind, Emory S. Kemler* reviewed and collated thousands of individual flow tests in order to evaluate the effects of roughness, pipe diameter, density, and viscosity on the flow of fluids through pipes.

Kemler's data were used by J. J. S. Pigott† as the basis for a tentative version of the λ vs. DV/ν chart to which, in addition to the Stanton line for "smooth" pipe, he added a series of complementary lines representing this functional relationship for commercial pipe of different diameters. Although based in part on speculative reasoning, the Pigott chart was a distinct step forward in providing design engineers with a guide for estimating friction coefficients founded on the Kemler analysis.

However, just as the Reynolds number reduced the several physical characteristics of a fluid into one significant parameter which, by its value, determines the dynamic state of the fluid passing through a pipe, Prandtl, Nikuradze, and von Karmán were able to encompass the effect of roughness into one "generalized roughness function" which, later, was applied by Colebrook‡ to determine the so-called "transition curve" between smooth and wholly rough conditions of flow along the pipe wall, as it applies to commercial steel pipe.

But before going further into the subject of a generalized roughness function and in order to prepare the way for an analytical expression representing it, it will be very helpful, first, to develop a somewhat different version of the Reynolds number which, incidentally, makes it possible to solve the Fanning equation directly for the flow rate when the pressure drop is given. By similar dimensional reasoning, a third criterion may also be developed which provides a direct solution for the pipe diameter when the pressure drop and flow rate are known.

*"A Study of the Data on the Flow of Fluids in Pipes," Trans. A.S.M.E., 1933.

†"The Flow of Fluids in Closed Conduits," M.E. 8-1933.

‡"Turbulent Flow in Pipes, with Particular Reference to the Transition Region Between the Smooth and Rough Pipe Laws," Journal of the Institute of Civil Engineers—1938-39.

The Flow Equation and Its Direct Solution for Pressure Drop, Flow Rate, or Diameter

Ordinarily, pipe-line engineers are accustomed to express the loss of energy in overcoming friction during flow in terms of loss of head or of pressure drop. However, it may just as readily be given in terms of fluid shearing stress. During steady fluid motion, this shearing stress at the pipe wall is given by:

$$\tau_o = -\frac{dp}{dl} \times \frac{D}{4} \text{ (lb./ft.}^2\text{)} \quad (2)$$

and if the fluid in the pipe is incompressible by:

$$\tau_o = -\frac{p}{l} \times \frac{D}{4} \text{ (lb./ft.}^2\text{)} \quad (3)$$

This can readily be verified by balancing the pressure differential between the end areas of a short section of pipe against the fluid shearing stress over the interior pipe wall area, as shown in Fig. 1.

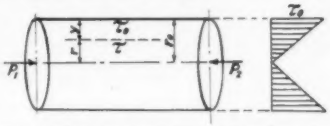

Fig. 1—Shearing stress diagram, circular pipe

A. Then, by proceeding on the basis that the flow of a fluid through pipe is governed by the pipe diameter D and the bulk velocity V, mass density ρ, absolute viscosity μ, and the shearing stress τ_o of the fluid at the pipe wall, it follows from the Buckingham π theorem that these five terms can be combined into two dimensionless groups which are linked by a functional relationship. The nature of this functional relationship is not revealed by this reasoning and must, therefore, be established by experiment, as was done by Stanton and Pannell in 1914. Accordingly:

$$\pi_1 = \phi' (\pi_2)$$

and, by definition π_1 must be dimensionless, so that:

$$\pi_1 = \mu^a D^b V^c \rho^d \tau_o^e =$$

$$(FT/L^2)^a L^b (L/T)^c (FT^2/L^4)^d (F/L^2)^e$$

and if we arbitrarily make $a = 1$ and $e = 0$, the remaining exponents as they apply to F, L, and T must add up to zero.

For

F: $\quad a + d = 0$

L: $\quad -2a + b + c - 4d = 0$

T: $\quad a - c + 2d = 0$

Solving these equations:

$a = 1$, $b = -1$, $c = -1$, $d = -1$, $e = 0$, hence:

$$\pi_1 = \mu/D\rho$$

Repeating the process by letting $a = 0$ and $e = 1$:

$a = 0$, $b = 0$, $c = -2$, $d = -1$, and $e = 1$, and therefore:

$$\pi_2 = \tau_o/\rho V^2$$

so that

$$\tau_o/\rho V^2 = \phi' (\mu/DV\rho)$$

$$= \phi (DV\rho/\mu) = \phi (N_R) = k \quad (4)$$

This is the well-known relationship familiar to all pipe-line engineers. This derivation has been here repeated because an extension of this same reasoning leads to another important and very useful parameter.

B. Proceeding exactly in the same manner as was done above, but by grouping terms, to wit:

$$\pi_1 = V^a D^b \tau_o^c \rho^d \mu^e =$$

$$(L/T)^a L^b (F/L^2)^c (FT^2/L^4)^d (FT/L^2)^e$$

and letting $a = 1$ and $e = 0$, we obtain:

$a = 1$, $b = 0$, $c = -\frac{1}{2}$, $d = \frac{1}{2}$, $e = 0$, and therefore:

$$\pi_1 = V\tau_o^{-1/2}\rho^{1/2} = V(\rho/\tau_o)^{1/2}$$

and for $a = 0$ and $e = 1$,

$$\pi_2 = \mu/D(\rho\tau_o)^{1/2}$$

so that:

$$\frac{V}{(\tau_o/\rho)^{1/2}} = \frac{V}{v^*} = \phi\left[\frac{D(\rho\tau_o)^{1/2}}{\mu}\right]$$

$$= \phi\left[\frac{D(\tau_o/\rho)^{1/2}}{\nu}\right] = \phi\left(\frac{Dv^*}{\nu}\right)$$

$$V/v^* = \phi (N^*) = a \quad (5)$$

N_R = Reynolds number

N^* = F.V. Reynolds number

ν = kinematic viscosity, μ/ρ, (ft.^{2}/sec.)

$(\tau_o/\rho)^{1/2} = v^*$ = friction velocity, (ft./sec.)

a = dimensionless parameter

The term $(\tau_o/\rho)^{1/2}$ will recur quite frequently, and, since it has the dimension of velocity, Prandtl has designated it as the "friction velocity." By the same token, the expression Dv^*/ν may be termed as the "friction velocity (F.V.) Reynolds number."

A most interesting and useful relationship may now be deduced from the transformations, namely:

$$\tau_o/\rho V^2 = \phi (DV/\nu)$$

from which it follows that:

$$\frac{V}{(\tau_o/\rho)^{1/2}} = \frac{V}{v^*} = \left[\phi\left(\frac{DV}{\nu}\right)\right]^{-1/2}$$

$$= (1/k)^{1/2} = (8/\lambda)^{1/2}$$

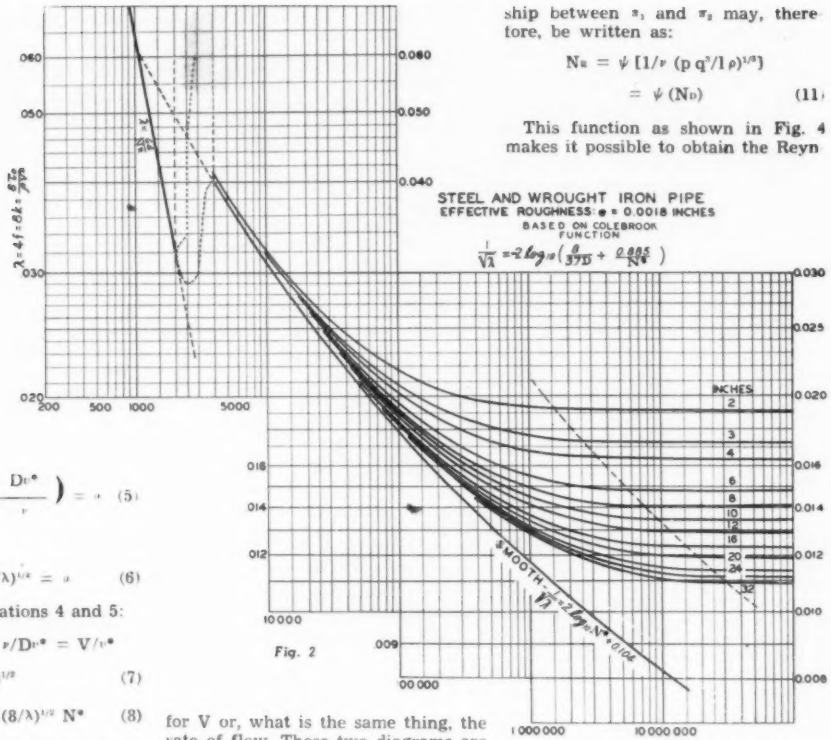

Fig. 2

but from (5):

$$\frac{V}{(\tau_o/\rho)^{1/2}} = \frac{V}{v^*} = \varphi\left(\frac{D\nu^*}{\nu}\right) = \alpha \quad (5)$$

and therefore:

$$(1/k)^{1/2} = (8/\lambda)^{1/2} = \alpha \quad (6)$$

but according to Equations 4 and 5:

$$N_R/N^* = DV/\nu \times \nu/D\nu^* = V/v^*$$

$$= \alpha = (8/\lambda)^{1/2} \quad (7)$$

and

$$N_R = \alpha N^* = (8/\lambda)^{1/2} N^* \quad (8)$$

Now going back to the definition for τ_o, namely:

$$\tau_o = -dp/dl \; D/4 \quad (2)$$

when the fluid is compressible, and

$$\tau_o = -p/l \; D/4 \quad (3)$$

for an incompressible liquid the F.V. Reynolds number may also be written in the form:

$$D\nu^*/\nu = N^* = 1/2\nu \; (pD^2/l\rho)^{1/2} \quad (9)$$

for an incompressible liquid, and,

$$D\nu^*/\nu = N^* = 1/2\nu \sqrt{\frac{(p_1^2 - p_2^2)\,D^2}{l\rho}} \quad (10)$$

in the case of compressible gas:

- p = pressure drop in lb./ft.²
- p_1 = initial pressure conditions (lb./ft.²) of a compressible fluid while flowing through a pipe.
- p_2 = final pressure conditions at the terminal end of the pipe (lb./ft.²).

It is to be noted that the terms in N* do not include the velocity V. Inasmuch as the relationship given by Equations 7 and 8 enable us to transform the regular Stanton and Pannell diagram into its counterpart for the relationship between N* and $\alpha = (8/\lambda)^{1/2}$ the way, thus, is paved for solving the Fanning equation directly for V or, what is the same thing, the rate of flow. These two diagrams are shown in Figs. 2 and 3.

C. A third dimensionless parameter which does not contain the pipe diameter D may be obtained if, in the group of terms considered under (A) and (B), τ_o is replaced by p/l and V by the flow rate q. Then, proceeding as before:

$$D^a q^b \mu^c \rho^d (p/l)^e =$$

$$L^a \; (L^1/T)^b \; (FT/L^2)^c \; (FT^2/L^4)^d \; (F/L^2)^e$$

and:

a = 1, b = —1, c = 1, d = —1, e = 0, so that:

$$\pi_1 = D\mu/\rho q$$

Then by choosing a = 0 and e = 1, we get for:

a = 0, b = 3, c = —5, d = 4, e = 1, so that:

$$\pi_2' = \frac{q^2 p \rho^4}{l \mu^5}$$

Since

$$\nu = \mu/\rho$$

$$\pi_2' = \frac{q^2 p}{l \rho \nu^5}, \text{ and } \pi_1 = \psi''(\pi_2')$$

becomes:

$$D\mu/\rho q = D\nu/q = \psi''(q^2 p/l \rho \nu^5)$$

$$= \psi'[1/\nu \; (p\, q^2/l\rho)^{1/5}]$$

But inasmuch as q = AV, $D\nu/q = 4/\pi N_R$, and the functional relationship between π_1 and π_2 may, therefore, be written as:

$$N_R = \psi[1/\nu \; (p\, q^2/l\rho)^{1/5}]$$

$$= \psi(N_D) \quad (11)$$

This function as shown in Fig. 4 makes it possible to obtain the Reynolds number N_R on the basis of flow rate and pressure drop when the pipe diameter D is not known. Before proceeding with an illustrative problem, attention is directed once more to Equation 4:

$$\tau_o/\rho V^2 = \varphi(N_R) = k$$

Then, by inserting for τ_o its equivalent as given in Equation 3, we obtain for the pressure drop which occurs in a flowing liquid while passing through a pipe:

$$-p = \frac{8\,k\,\rho\,l}{D} \frac{V^2}{2}$$

and if expressed as the pressure required to overcome the frictional resistance, this becomes:

$$p = \frac{8\,k\,\rho\,l}{D} \frac{V^2}{2} = \frac{\lambda\,\rho\,l}{D} \frac{V^2}{2}$$

$$= \frac{\lambda\,l\,\gamma}{D} \frac{V^2}{2g} \text{ (lb./ft.}^2\text{)} \quad (12)$$

But since $p = \gamma h_f = g\rho h_f$

$$h_f = \frac{\lambda\,l}{D} \frac{V^2}{2g} \text{ (ft.)} \quad (13)$$

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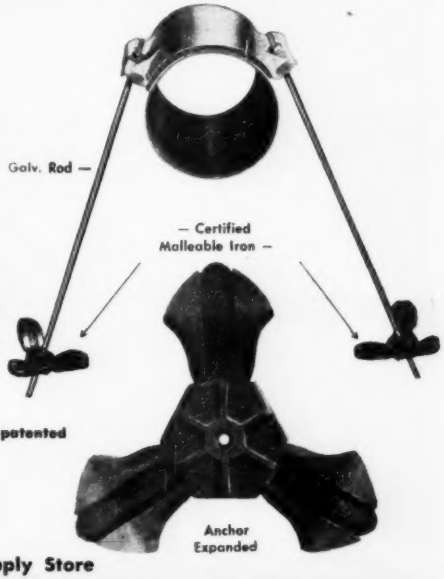

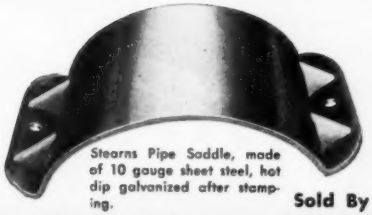

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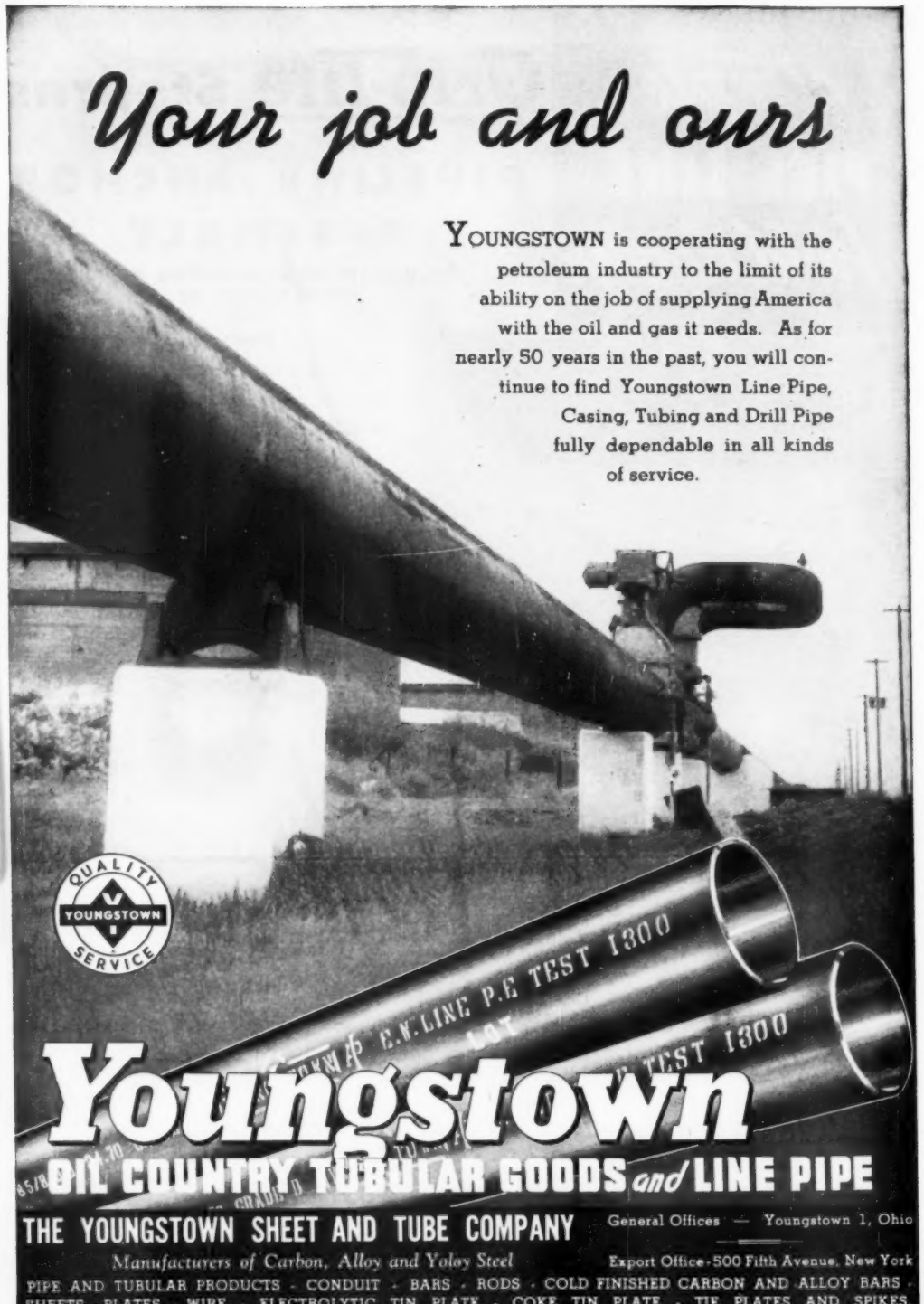

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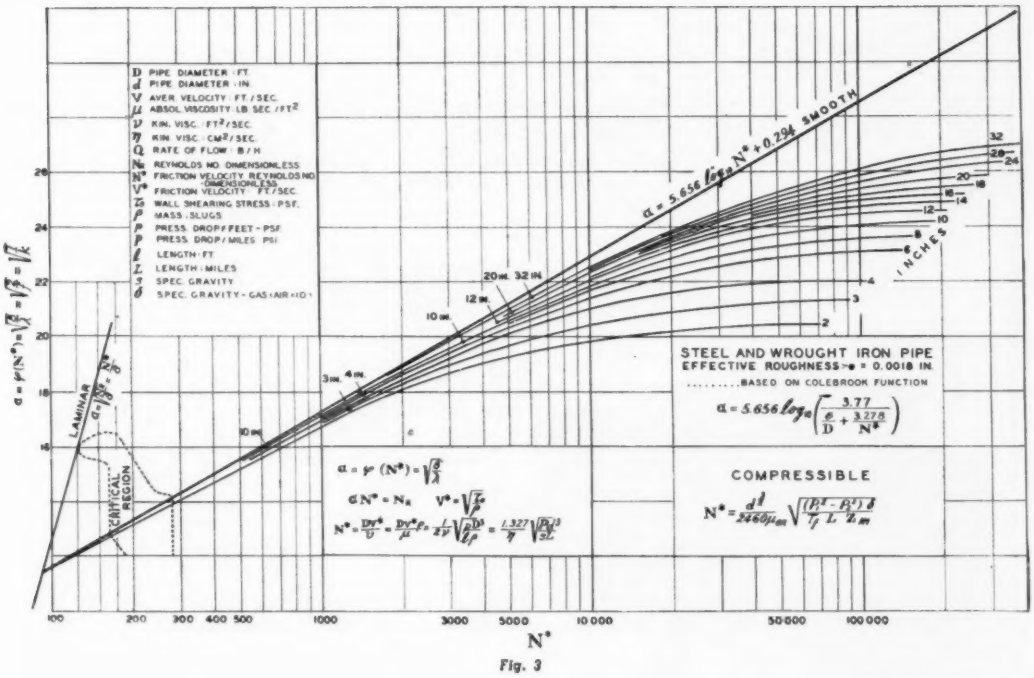


Fig. 3

p = pressure, lb./ft.²
γ = weight density, lb./ft.³
h_f = friction head, height of equivalent column of flowing liquid according to $p = \gamma h_f$, (ft.).

and when solving for p or for h_f, the equation can be evaluated by means of $\lambda = \phi\,(DV/\nu)$ which is available from the Stanton and Pannell diagram. On the other hand, if the flow rate q (ft.³/sec.) is to be found, Equations 12 and 13 readily transform into:

$$q = a\pi/8\ (pD^5/l\rho)^{1/2}$$

$$= \pi/(8\lambda)^{1/2}\ (pD^5/l\rho)^{1/2}$$

$$= a\pi/8\ (gh_fD^5/l)^{1/2}\ (ft.^3/sec.) \quad (14)$$

and in this case:

$$a = (8/\lambda)^{1/2} = \phi\ (Dv^*/\nu)$$

$$= \phi\ [1/2\nu\ (p\,D^3/l\,\rho)^{1/2}]$$

can be taken from the chart, Fig. 3, giving the a vs. N* relationship. In their present form, Equations 11 and 13 are valid only for a level pipe line.

The solution for D, required for the calculations of a line of equivalent diameter, takes the form:

$$D = [(8/\pi^2)\ (\lambda\rho lq^2/p)]^{1/5}$$

$$= [(8/\pi^2)\ (\lambda lq^2)/gh_f)]^{1/5}\ (ft.) \quad (15)$$

and in this case the value of λ can be found from the relationship $N_R = \psi\,(N_D)$ as shown in Fig. 4.

$$N_D = 1/\nu\ (p\,q^2/l\,\rho)^{1/2} \quad (11)$$

If the pipe line is inclined to the horizontal and there is a static head in either the positive or the negative direction, this static head must be deducted or added to the total head, as the case may be.

Example

As an illustration, consider a level oil pipe line of 12¼-in. inside diameter and a length of 50 miles. The oil passing through the line is of s = 0.85 specific gravity and has a viscosity of 60 S.U.S. = 0.1 Stokes.

A. What is the pressure drop for a flow rate of 3,000 bbl. per hour?

(Continued on page 322)

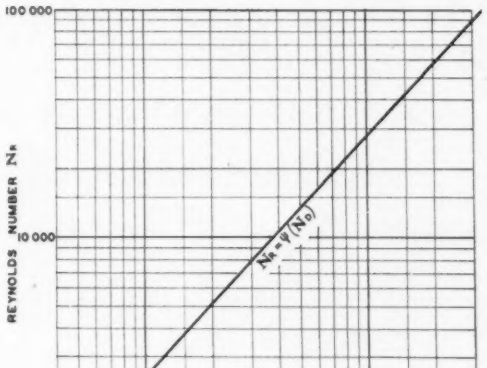
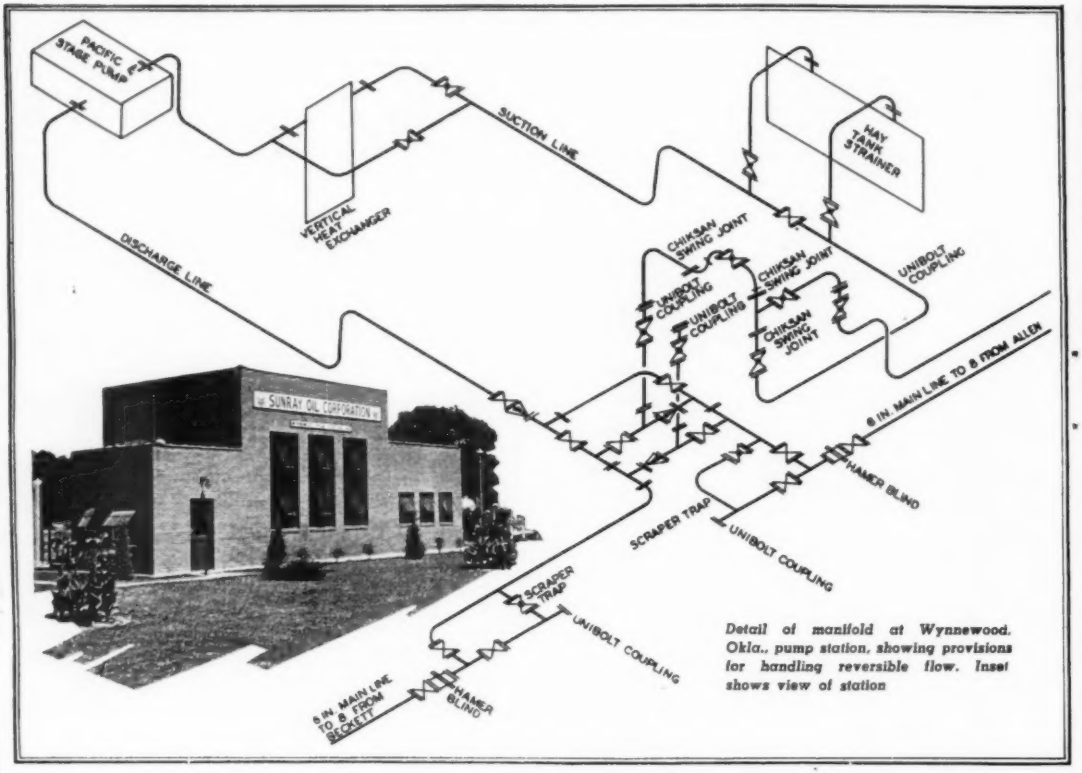


Fig. 4



Detail of manifold at Wynnewood, Okla., pump station, showing provisions for handling reversible flow. Inset shows view of station

REVERSIBLE PIPE LINE

Pumps gas-oil charge stock one way—distillates and blending stocks the other

by J. R. Ellis

SUNRAY OIL CORP. placed in operation during 1948 a plant utility system to connect its refineries at Allen and Beckett, Okla. The system consists of 96 miles of 6-in. line and three pump stations—one at each end, Allen and Beckett, and an intermediate station at Wynnewood. Flow in the line is reversible; thus, as requirements dictate, the line is used interchangeably to pump gas oil charge stock from Allen and Wynnewood to Beckett or distillates and blending stocks from Beckett to Allen.

Line capacity ranges from 10,000 bbl. a day for heavy gas oil to 17,000 bbl. a day for the lighter products at pump discharge pressure of 1,100 psi. Products handled range from 23° A.P.I. gravity, 100 S.S.U. viscosity at 100° F. wth cold test of 40° or higher gas-oil charge stock, to high-gravity gasolines of various vapor pressures with a considerable quantity of intermediate distillates.

All products are batched through the line, changes in products being determined by gravity changes and by hourly checks of quantity pumped by the receiving and pumping stations to predict time of arrival of product changes.

Contamination has not been a serious factor in operation of the line in spite of the wide range of products handled. Due to the loss of time resulting from the necessity of displacing the line fill each time the line is reversed, which amounts to slightly over 1 day's pumping time, an effort is made to accumulate as large a batch as possible before reverse pumping is started. For this reason, 80,000-bbl. storage tanks were erected

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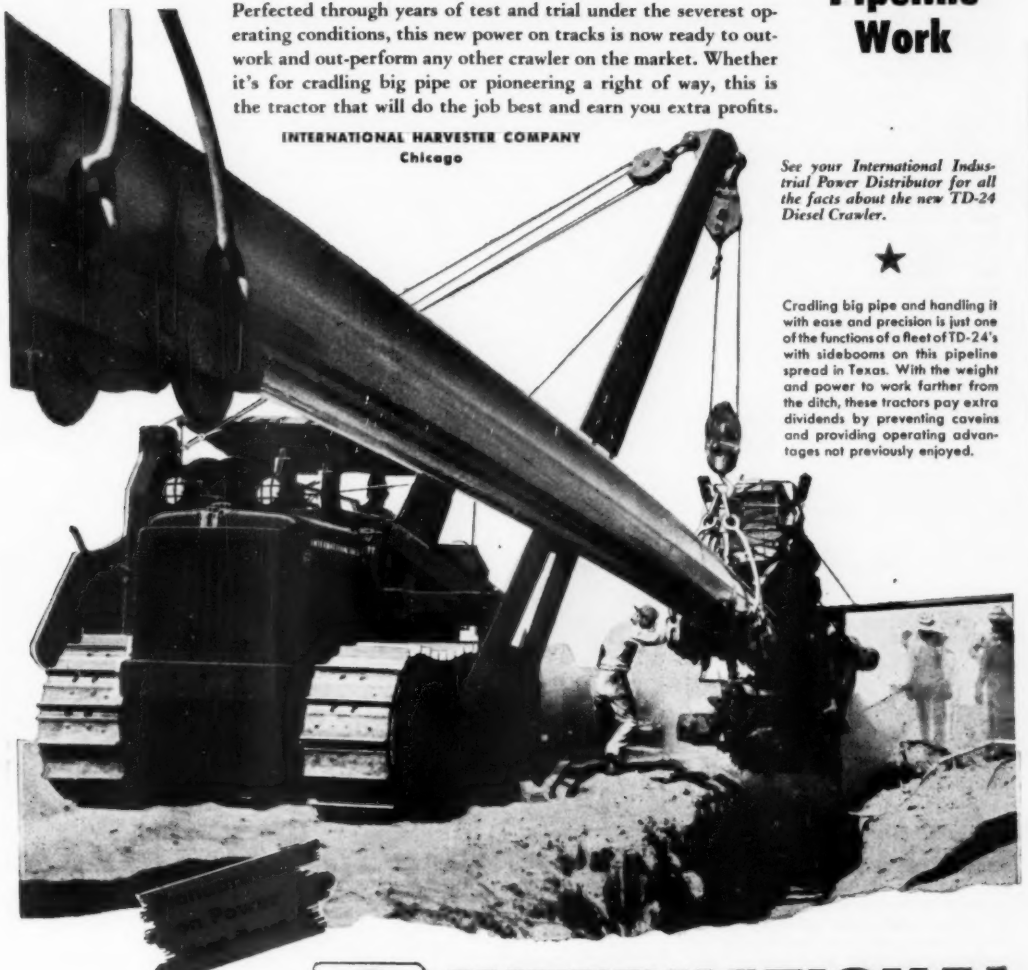

Cradling big pipe and handling it with ease and precision is just one of the functions of a fleet of TD-24's with sidebooms on this pipeline spread in Texas. With the weight and power to work farther from the ditch, these tractors pay extra dividends by preventing caveins and providing operating advantages not previously enjoyed.

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in sufficient number so that in normal operation it is necessary to reverse the flow not oftener than once a month.

Due to the high cold test, resulting from the high wax content of the gas oil pumped, a buffer stock of light distillate was used to wash the line in the event any of the heavy material should be deposited on the internal surface of the line and then leach off in the lighter material following. It was found shortly after the line was placed in operation that there was not sufficient contamination to justify segregation of stock for use in flushing line. Batching plugs consisting of rubber-disk and wire-brush pipe-line scrapers were substituted and satisfactory results were obtained. The use of batching plugs has been largely eliminated recently, since experience has shown the commingling of the products is very slight and this can be handled by a minimum amount of mixture being slopped to the lower grade.

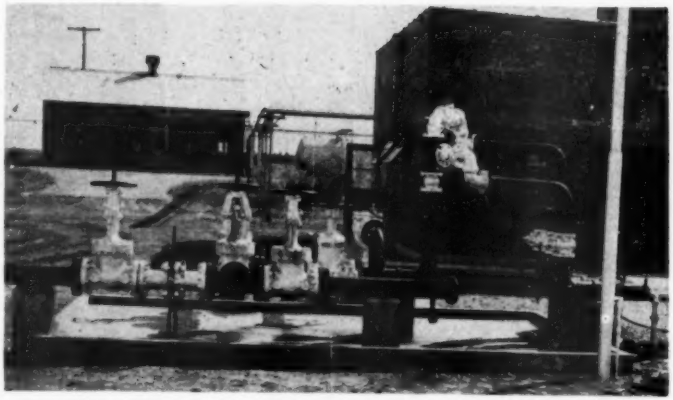
Recent studies made of soluble gums in gasoline moved through the line behind heavy gas oil shows some increase in gum content of the first few hundred barrels of gasoline following the heavy stock as indicated by stream samples. However, we have been unable to detect an increase in gum after the entire batch, 25,000 bbl. or more, is placed in storage. It is usually necessary to slop approximately the first 100 bbl. of the light product following the heavy material due to discoloration, and this material picks up most of the soluble gum that leaches off of the pipe walls.

An attempt is made to schedule shipments of the heavy gas oil to avoid periods of extreme cold weather. However, shipments have been made when the atmospheric temperature was as much as 40° F. below the pour point of the material. While ground temperatures are usually above the pour point, precautions are taken to keep the flow uninterrupted as a considerable portion of the line is exposed to the atmosphere, due to the fact that all stream crossings are of the overhead type. The only occasion that might cause flow to be stopped would be a major line break. Interruptions due to mechanical failure can be overcome by either bypassing the station having trouble or reversing the flow.

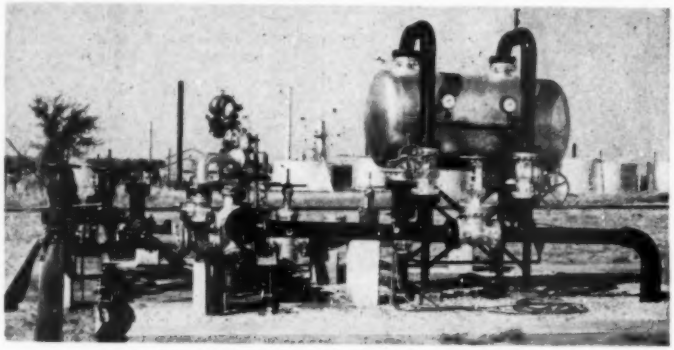
(Continued on page 323)

The Author

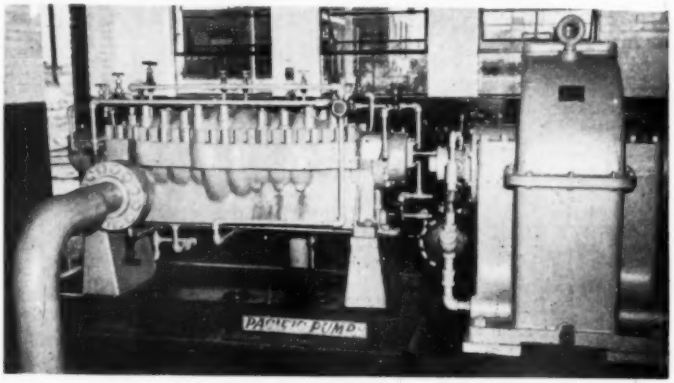
J. R. (Dick) Ellis, vice president of Sunray Pipe Line Co. and manager of pipeline division of Sunray Oil Corp., has been with Sunray since May 1947. He started in the pipe-line industry with Great Lakes Pipe Line Co. in 1934, serving successively as laborer, gager, district clerk, terminal superintendent, and engineer. As field engineer, he assisted in construction of new lines in Kansas, Nebraska, Minnesota, and the Dakotas. He was transferred to Oklahoma in 1947 to construct the line from Tulsa to Allen, Okla., and upon completion of this line joined Sunray. He was born at Miami, Okla., April 4, 1910, and attended school at Oklahoma A. & M. College.



Manifold at Beckett, Okla., pump station which is the initial point for shipping and receiving



Hay-tank type of filter installed at Wynnewood station



Pump room at Beckett station showing eight-stage centrifugal pump with speed increaser having 5.85 to 1 ratio for stepping up 600-r.p.m. engine speed to drive pump at 3,510 r.p.m.

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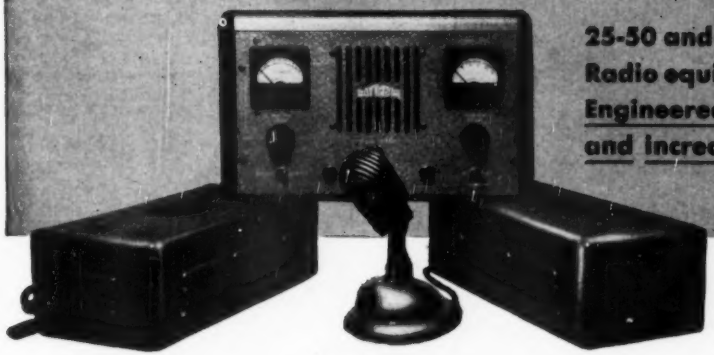

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BATCHING *in Products Lines*

by L. R. Dickinson

THE ability to handle satisfactorily both gasolines and distillates extended the utility of product pipe lines so that terminals and branch lines were added to the older lines and additional lines were constructed into new areas. Product lines which were presumably designed with adequate reserve capacity are already confronted with the need for peak operation, in order to meet their throughput requirements.

The widely branching pipe-line systems, the wide variation in products transported through the line, and the many terminals, which in some instances have storage-tank facilities below normal for pipe-line operation, create scheduling and dispatching problems which are troublesome, particularly in cases where peak operation of the system is desired.

In our own case, it was evident that we must determine quickly and accurately maximum throughput rates under any and all operating conditions if peak operation of the pipe lines were to be maintained. It was considered imperative that the method employed require a minimum of time for operation, be sufficiently accurate for practical use, and be simple enough in execution so that reasonable proficiency in its use could be readily attained.

In an effort to satisfy our own needs a graphical method has been developed for determining flow and pressure conditions throughout our pipe-line system.

Simplified Chart

A chart has been prepared in a simplified form and is presented here, together with an example illustrating the manner in which it is used. The chart indicates pressure and flow conditions throughout the pipe-line system by means of pressure-gradient lines developed from two nomographs in the upper portion of the chart, one for determining pressure drop on gasolines and the other for fuel oil.

Temperature correction is provided in the nomograph for fuel oil but no temperature correction has been provided for gasoline since the differences in the viscosity of gasoline due to change in ground temperatures are very nearly canceled by corresponding increases in volatility which are regularly made to offset seasonal driving conditions.

The chart represents a 6-in. pipe line, approximately 118 miles in length. However, to facilitate its use in dispatching, its length is indicated in thousands of barrels. Three profiles have been plotted, one (solid line) indicates the elevation of the line with respect to sea level, in accordance with the scale on the right of the chart, "Elevation in Hundreds of Feet."

All flow-gradient lines could be set up on basis of feet of head, in which case this profile would suffice; however, it would then be necessary to convert "head in feet" to pounds per square inch in order to correspond with pressure-gage readings. To avoid this step, profiles based on the static head pressures in pounds per square inch for gasoline and fuel oil have been plotted corresponding to the elevation profile.

Extended scales for each product are provided at points where withdrawals or changes in the rate of flow are likely to occur. Thus any information developed from the chart is directly applicable to operation of the line for which it is prepared. On the chart, points of withdrawal are indicated namely, terminals, Nos. 1, 2 and 3. For purposes of illustration gasoline is being delivered by the

L. R. Dickinson, manager of the Eastern Pipe-Line Division, Socony-Vacuum Oil Co., Inc., has had a number of years' experience in the design, construction, and operation of crude-oil lines, product pipe lines, and terminals. He was first employed by Socony-Vacuum in March 1931 and served as chief engineer of the White Eagle pipe-line department, at Wichita, Kans., until April 1, 1948, at which time he was transferred to his present position with offices at 26 Broadway, New York.

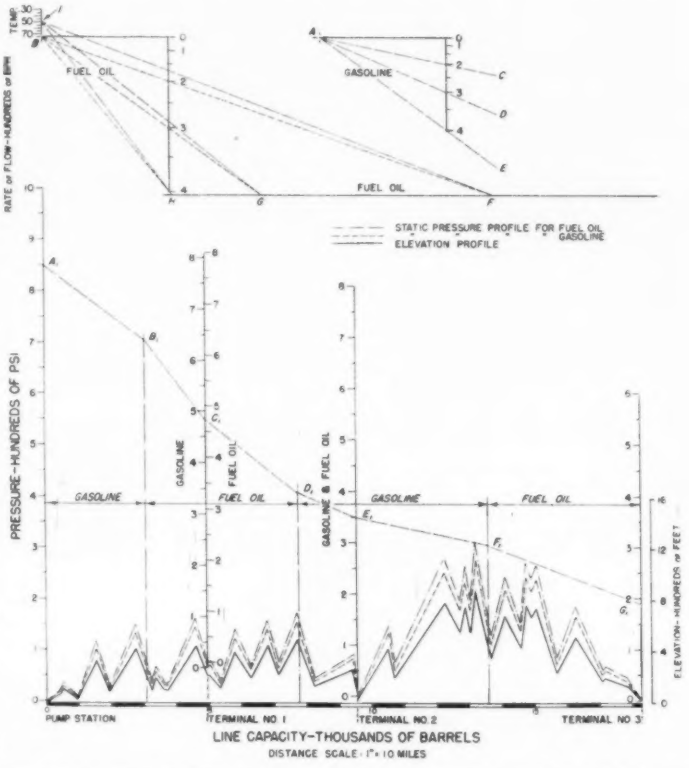
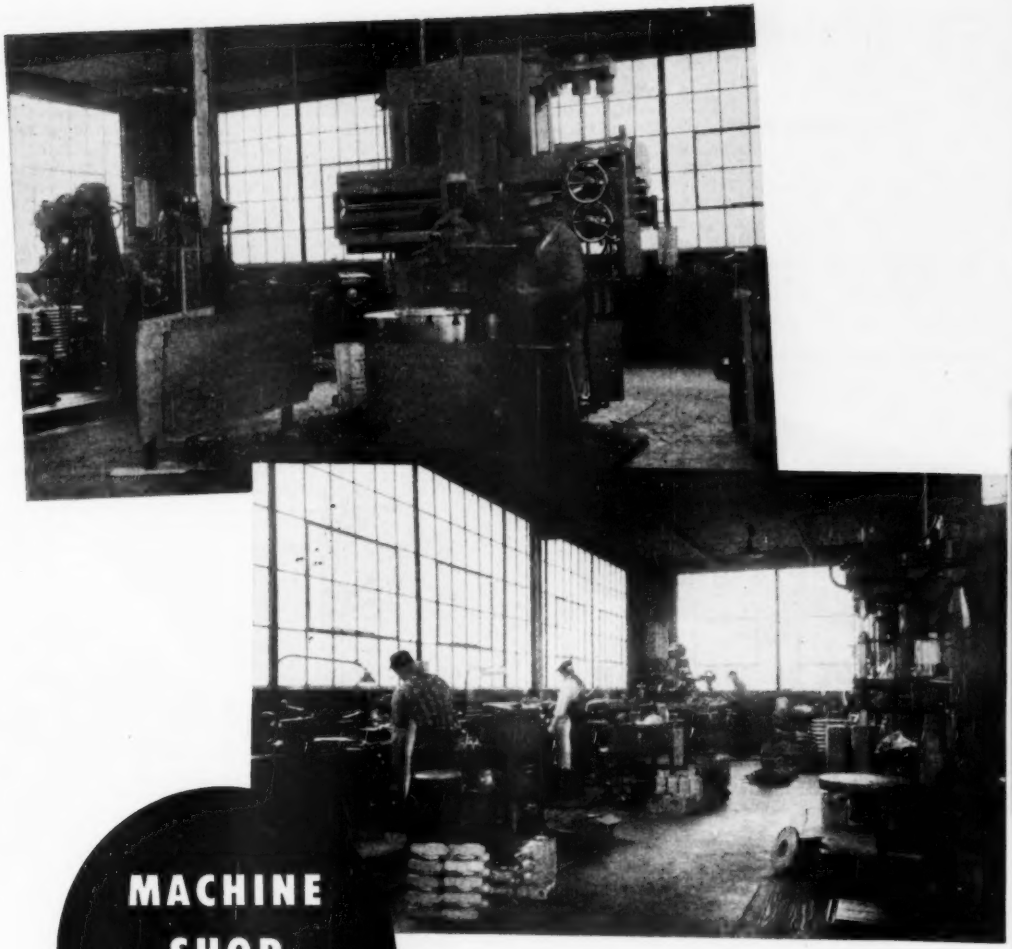


Chart for problems involving pressure drop in lines transporting gasolines and fuel oils



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pump station into the line, preceded by alternating batches of fuel oil and gasoline. Gasoline is being pumped into the line at a rate of 400 bbl. per hour.

Product Temperatures

The pipe-line product temperatures are assumed to be 50° F. Delivery is being made at terminal No. 1 at a rate of 100 bbl. per hour. Starting with an initial pump pressure of 850 psi. and a rate of 400 bbl. per hour, the originating pressure gradient is obtained by plotting a line A-E on the gasoline nomograph and transferring it to position A_1-B_1.

At point B_1, the product in the line changes to fuel oil. The line B-H is drawn on the fuel-oil nomograph for the specified rate. Connecting the point where B-H intersects the base line and the product temperature (50° F.), we obtain the corrected pressure gradient line I-H. Line I-H is transferred to the chart as shown by line B_1-C_1, which ends at terminal No. 1. At this point, 100 bbl. per hour is being withdrawn; therefore, our rate of flow from this point becomes 300 bbl. per hour.

Since the product remains unchanged, line B-G is drawn for a rate of 300 bbl. per hour. The corrected pressure gradient I-G, is transferred to the chart in position C_1-D_1. At point D_1 the product changes to gasoline; however, the rate remains at 300 bbl. per hour. Therefore, line A-D is drawn on the nomograph for gasoline. This pressure gradient on the chart is indicated by line D_1-E_1, which ends at terminal No. 2, where 100 bbl. per hour is also being withdrawn from the line. The remaining 200 bbl. per hour is being pumped to terminal No. 3. The pressure gradient E_1-F_1 is drawn parallel to line A-C on the nomograph for gasoline. At point F_1, the product changes to fuel oil and the lines B-F and I-F are drawn. The corrected pressure gradient (Line I-F) is represented on the chart by the line F_1-G_1. At point G, or terminal No. 3, the residual pressure is found to be 190 psi.

Actual Work Done Quickly

We have now drawn hydraulic gradients for the entire pipe line indicating gage pressures along the line and at the terminals. Although the above description appears to be involved, the actual work of laying out the hydraulic gradient requires only a short period of time.

We feel that if a dispatcher were presented data similar to that shown on the chart and which applied to the pipe line for whose operation he was responsible, he would at least consider the possibility of changing flow and withdrawal rates in an effort to utilize the indicated residual pressure of 190 psi. at terminal No. 3 as a means of increasing the line throughput.

With this chart the dispatcher can ascertain the line pressure at any point, rates of flow, and the back pressures at terminal points. By shifting these variables he can obtain peak pipe-line operation. Furthermore, in the event of equipment failure or other difficulties, the dispatcher of the pipe-line system has at his disposal a means whereby he can readily and rapidly readjust operations to obtain a maximum throughput available under those conditions.

Every pipe line has its own individual operating characteristics and although we have had this type of chart in operation only a very short time, and it has been prepared on the basis of actual line elevations and in accordance with accepted flow formulas, indications are that the chart, though theoretically correct, must in fact be revised to take into account idiosyncrasies of the pipe line to which it will actually be applied.

It is highly probable that similar and perhaps better methods are being used for the same purpose. Nevertheless, it is hoped that the foregoing discussion may be of assistance to others confronted with the problem of maintaining a product pipe-line system at the level of peak operation.

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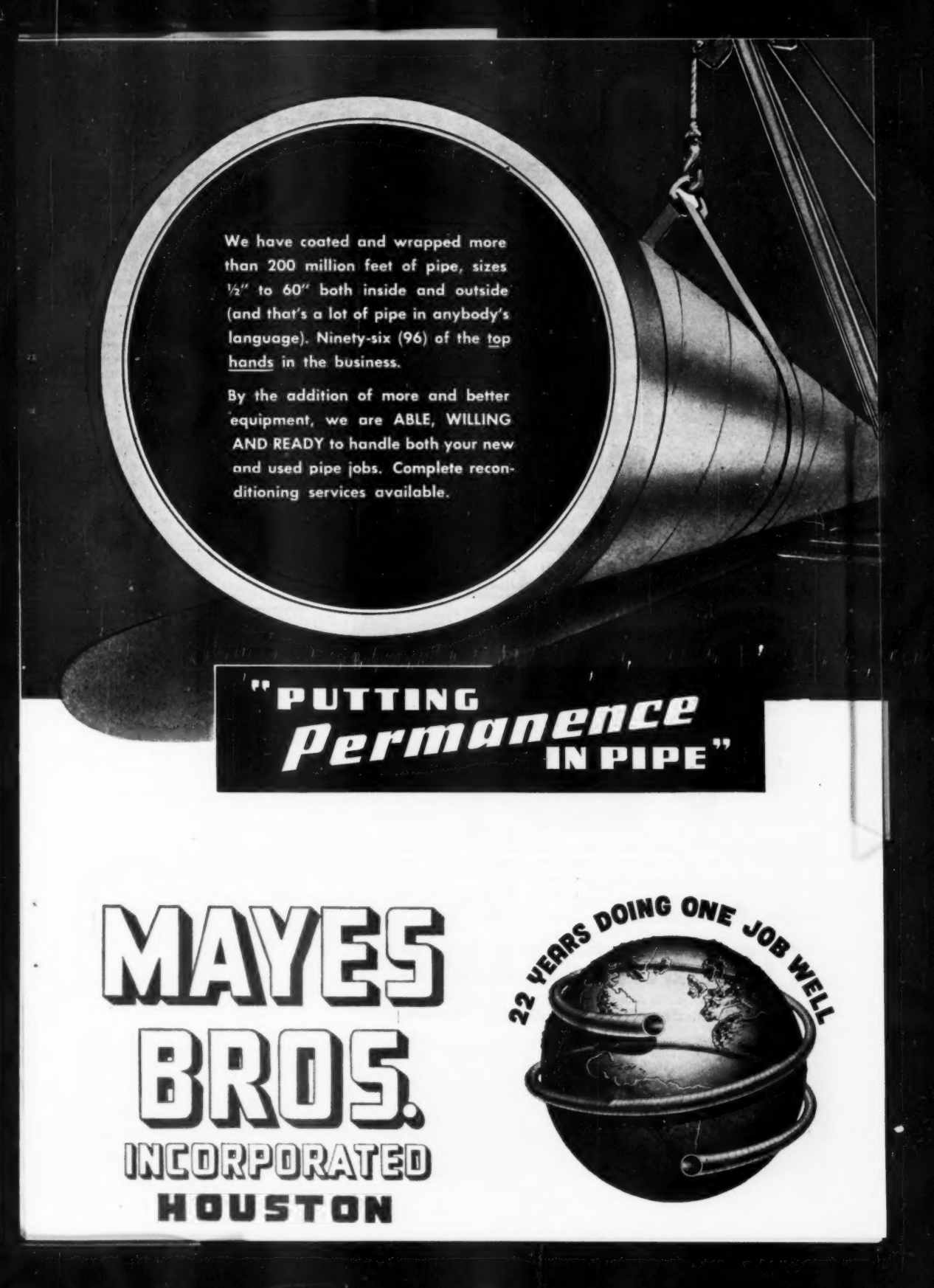
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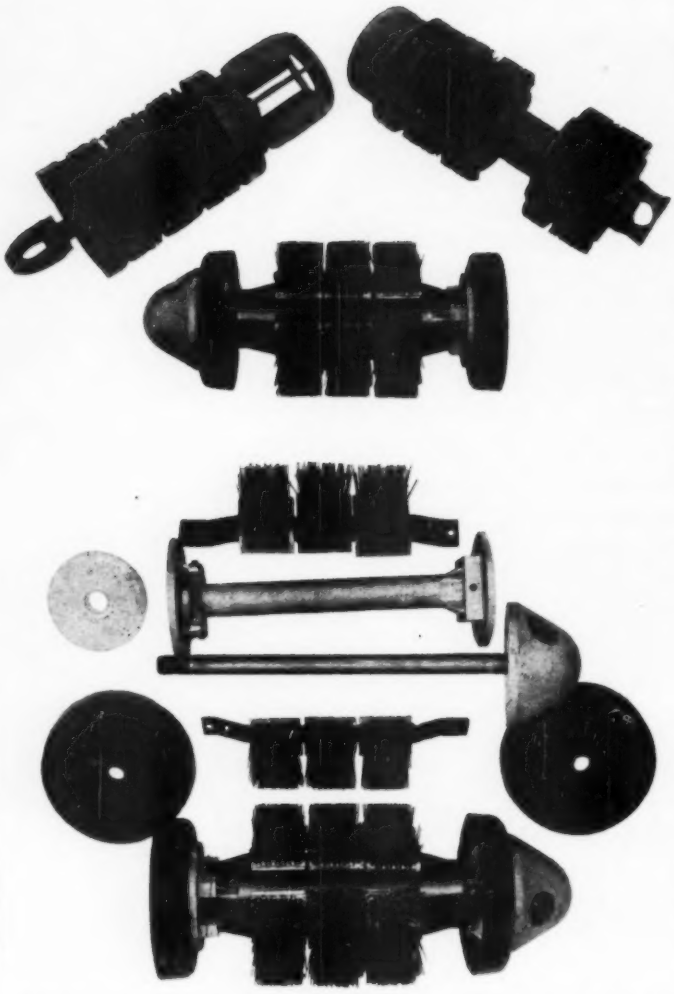

At top appears the progressive development steps of the older type scraper; the lower photos show the individual parts of the new type scraper described here, as well as the unit assembled

A New Development in

PIPE-LINE SCRAPERS

by G. P. Jennings and Fred B. Crandall

THE problem of scraping the interiors of pipe lines, both crude and products, is one that has confronted the petroleum industry since pipe lines first were used. Although recent improvements in the fields of pipe-line design and operation have almost eliminated the need for scraping products lines, most older lines still require scraping at regular intervals.

Several years ago Phillips Petroleum Co. adopted the "hairpin" steel brush-type scraper on its 8-in. products line from Borger, Tex., to St. Louis and Chicago. This scraper consisted of three pairs of steel "bobby pin"-type bristle brushes held in place in grooves between circular disks and mounted between rubber cups. These scrapers were similar to those now commonly manufactured by several companies. They were held together by alloy steel shafts running longitudinally through the center with alloy steel nuts locking them in place. These scrapers had the advantage of being tightly assembled units with no parts to come loose in the line. Since the brushes were ⅛ to 3/16-in. larger in diameter that the inside pipe diameter, the scraping action was positive when the scraper first started. However, before long the wear on the bristles and the bending effect seriously reduced the scraping action. It was found that brushes could not be used after running about 50 to 60 miles. By replacing brushes at every other station the scrapers worked fairly well.

The next model adopted was similar in construction but had a longer span between rubbers with the third brush trailing the rear rubber. It was considerably different in appearance but proved to be little more efficient in operation. Tests made calculating Hazen-Williams "C" values proved that the interior of the pipe was considerably cleaner on the sections closer to the input stations. The

The Authors

G. P. Jennings is chief engineer of the products pipe-line department of Phillips Petroleum Co. A native of New York State, he obtained his M.E. degree at Rensselaer Polytechnic Institute in 1923. He served Worthington Pump & Machinery Corp. for 3 years as service engineer, and for 2 years was in the zinc industry as design engineer. He joined Phillips in 1930 and was appointed to his present position in 1942.

Fred B. Crandall joined the products pipe-line department of Phillips as an engineer in January 1948. He

G. P. JENNINGS

F. B. CRANDALL

entered Iowa State College in 1940 to study engineering. In 1942 he enlisted in the Army, was later commissioned, and served as a first lieutenant with an armored artillery battalion in Germany. He returned to Iowa State on being relieved from active duty in 1946, and continued his education, receiving a B.S. degree in mechanical engineering in 1947.

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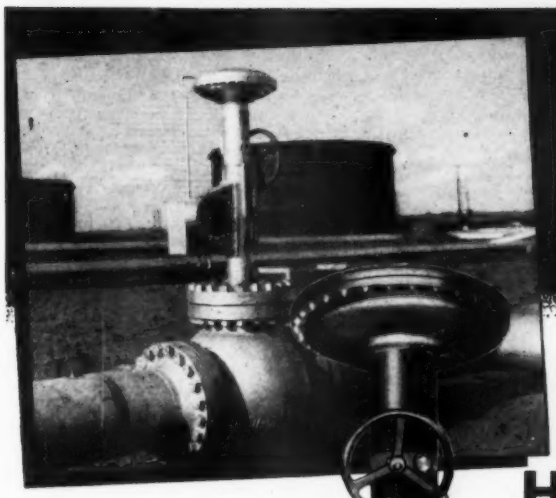

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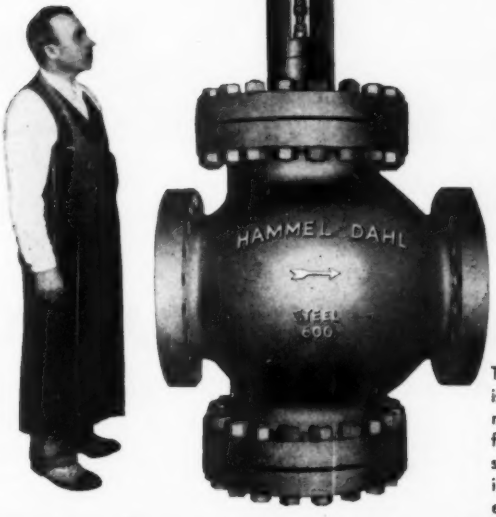

The 16" Hammel-Dahl, 3000 Series, Diaphragm Control Valve illustrated is typical of the many Hammel-Dahl Valves used in major pipe line installations.

The oversized bowl of the valve body has been designed to assure minimum pressure loss. Thru bolting on the bonnet and blind flange, together with the self-supporting ALLSTEEL Superstructure, are the ultimate in rugged construction.

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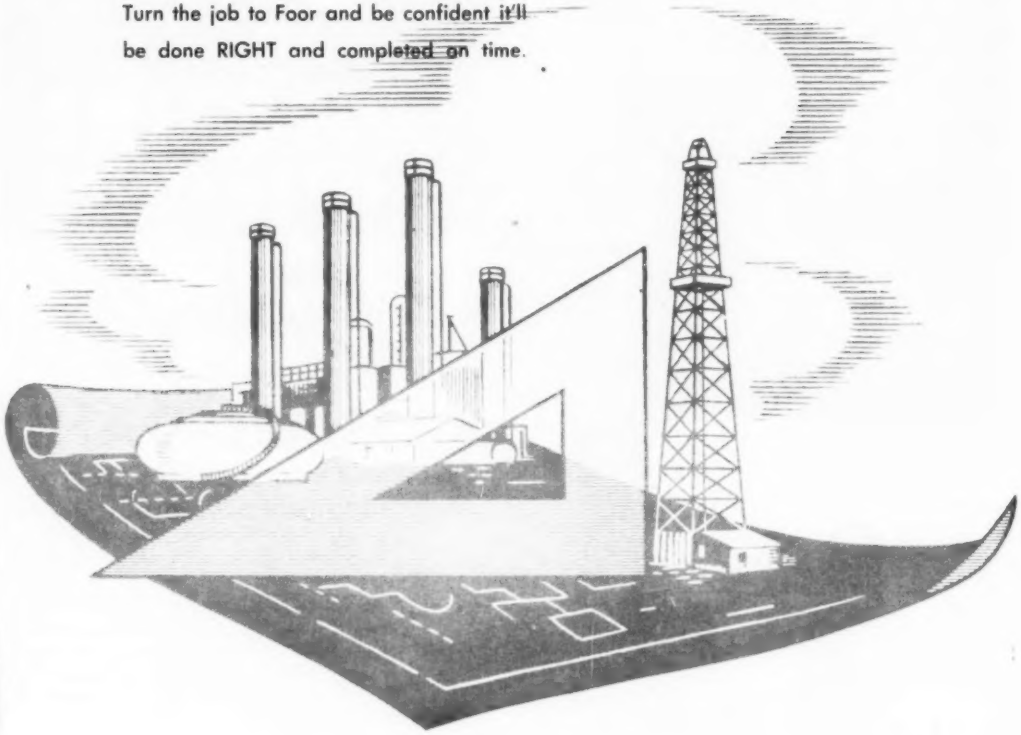

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- Specialized Installations

scrapers were not cleaning as well toward the end of the run.

The heart of the problem was to find a scraper which would provide a more or less uniform scraping action throughout its travel, i.e., a scraper which would wear the brushes down and continue to press uniformly on the interior of the line. In June 1948 Phillips ran its first scraper which approached this goal.

This new scraper was a steel-framed unit similar in appearance to the previous model, but the "new look" had been added to the brush arrangement. The old half-brush segments had been cut in two and mounted on each of four steel leaf-type longitudinal springs, between the rubber cups. When free, the outside diameter of the brushes was about 10 in. or 2 in. greater than the pipe diameter. When compressed the brush segments formed tight circular brushes ⅛ to 3/16 in. larger in diamerter than the inside pipe diameter. The spring tension held the brushes tight against the wall of the pipe even though the bristles were worn and bent.

Weight Excessive

This experimental model was first run between Paola station, Kansas, and Leeton station, Missouri, a distance of 49.4 pipe-line miles. It brought in an unusually large amount of sediment and arrived in good condition. However, the rubbers and brushes were worn more on the bottom than anywhere else, indicating that the weight was excessive.

To combat this, most steel parts were changed to aluminum, and two new models were made. Only the brushes, spring leaves, bolts, and center shaft remained steel. All other parts were cast aluminum. These new models were started from Paola and run to Villa Ridge station, Missouri, a distance of 222.4 pipe-line miles. The rubbers were then replaced and they were started out of Paola again. At each stop the scrapers were checked to see if they were still scraping efficiently. They were then sent on. When they reached Villa Ridge the second time the brushes were worn to the point where replacement was necessary. The total line scraped by each set of brushes was 445 pipe-line miles, or about nine times the life of old-style brushes.

The manufacture of scraper brushes involves considerable hard work with resulting high costs. In the life of one set of spring-mounted brushes enough money is saved on replacements to manufacture eight new aluminum frames complete with everything except brushes and rubbers. The light-weight aluminum frame also reduces wear and tear on rubber cups. These factors contribute heavily to the recent decision by Phillips to begin operation of these scrapers on a larger scale.

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Manifold with meters, strainers, and hay tanks. In left foreground are aboveground lines to tankage. Calibration tank is at right

Magnolia Pipeline's Hebert Terminal designed and planned to provide for

Minimum Interruption and Product Commingling

by G. A. Lundberg

G. A. Lundberg is at present with the mechanical-engineering department of Magnolia Pipe Line Co. in Dallas. He joined the company in 1939 after receiving his degree in mechanical engineering from Texas A. & M. College, and has been working on design of crude-oil and gasoline pipe lines since that time.

IN planning for the design of the Hebert terminal at the initial point of Magnolia Pipe Line Co.'s 178-mile, 12-in. products line from the Beaumont-Port Arthur area to Hearne, Tex., the objective of the company was to provide facilities which would insure accurate handling of products with minimum interruptions and minimum commingling of products. Emphasis was put on economy and simplicity, both in design and operations.

Some of the significant features to which attention will be directed in this article are the methods for protecting meters and pumps by settling tanks, hay tanks, and strainers; installation of station and tank-farm piping aboveground with expansion joints; suction booster pumps with three-way check valves at each of the tanks, and the procedure for identifying accurately the head of a products batch (tender head) arriving at the terminal.

Before discussing these features separately, it would be appropriate to describe the whole system and some of the equipment used in handling the products.

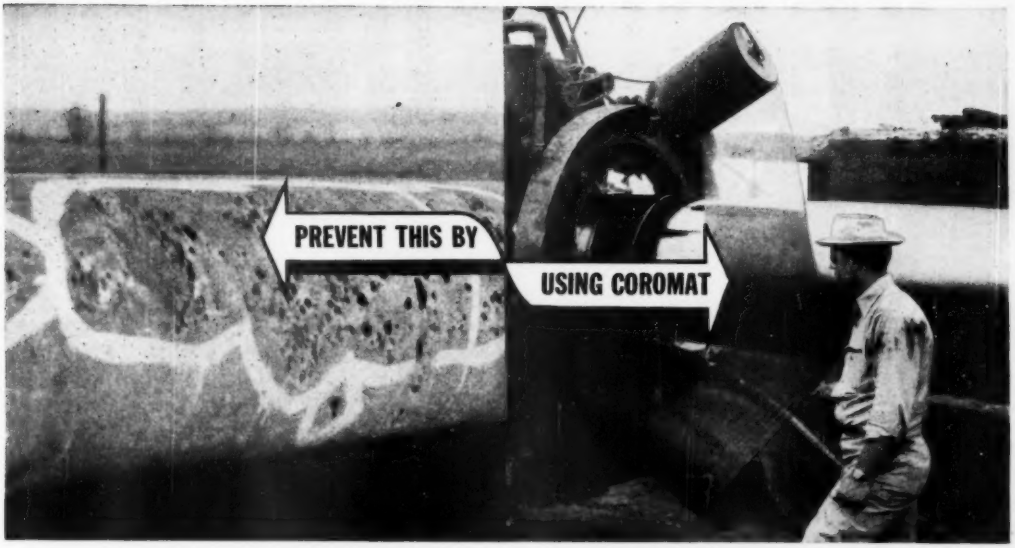
Products are received at Hebert station through 8 miles of 12-in. line from the Texas Co.'s refinery at Port Arthur and through 7 miles of telescoped 6, 10, and 12-in. line from Magnolia Petroleum Co.'s Beaumont refinery. All lines from the refineries are owned and operated by Magnolia Pipe Line Co. as well as the receiving facilities within the refineries. These receiving facilities consist of a settling tank which removes all free water, mill scale, and a major part of the iron oxide before the product goes to the pumps. When the product leaves the pumps it goes through filters which are fitted with 100-mesh bronze screens for removing the extremely fine particles still held in the product. From the filters it goes through rotary-type meters where it is measured and the amount pumped is printed on the run tickets. After that a solution of sodium chromate and water is injected into the stream for inhibiting corrosion. Also in each setting there are facilities for calibrating the meters.

When the products come into Hebert station they are run through hay tanks for removing any solid particles that might have been picked up by the stream from the main incoming lines as well as removing the unspent chromate mixture. The products are then filtered through 100-mesh bronze screens and metered into the storage tanks.

Before the products are pumped into the main line toward Houston and Hearne they are again filtered through hay tanks and filters, then metered, and sodium chromate injected into the product. Between Hebert station and the Hearne terminal, deliveries are made to Houston through an 11-mile 6-in. line from the 12-in. line near Aldine. Flow through this 6-in. line is controlled by a back-pressure regulator which assures a definite flow rate while bleeding off of the main line and automatically closes this line when the stream is stopped in Houston, thereby minimizing commingling under shutdown conditions.

At Aldine the products going to Houston are metered; and they are again metered when delivered to the sales terminals, thus giving a check on the 6-in. line for leaks. This is very essential as the line runs through a highly congested area and a leak must be detected immediately. At the sales terminals the meter settings are similar to those at the refineries, consisting of settling tanks, filters, and meters but the meter capacities are not nearly as large, as these settings were not designed for full-stream delivery.

The products not delivered into Houston continue on to Hearne and are delivered through meters to Texas Pipe Line Co. at its terminal there



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4. ***HIGH PICKUP:*** fineness of glass fibers gives a larger surface area for coating to cling to; permits more coating to be absorbed in a given thickness of wrap.
5. ***HEAT RESISTANT:*** withstands temperatures up to 1000°. Retains full strength under hot applications of impregnants.
6. ***MOISTURE RESISTANT:*** Coromat's glass fibers resist moisture, maintaining excellent water resistance qualities of coating.
7. ***ACID RESISTANT:*** fully resistant to organic solvents and soil acids. Helps impregnant combat electrolytic solutions.
8. ***NON-CORROSIVE:*** Coromat, being made of glass, is fully oxidized. Does not corrode or cause corrosion in contact with metals.
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10. ***DIELECTRIC STRENGTH:*** non-hygroscopic Coromat helps maintain high natural dielectric strength of coating.

HOW COROMAT CUTS COSTS

FASTER APPLICATION: in Coromat, extra-strong glass yarns have been added to Fiberglas Underground Pipe Wrap *increasing its tear strength 400%!* This permits high-speed application without delays caused by breaks. Longer 1200 foot rolls can be used, eliminating frequent machine stops.

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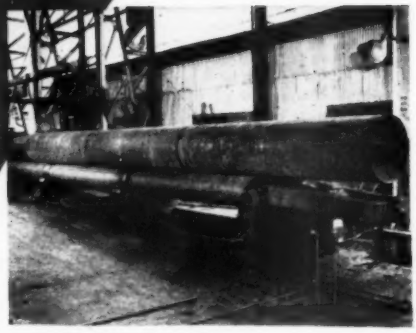

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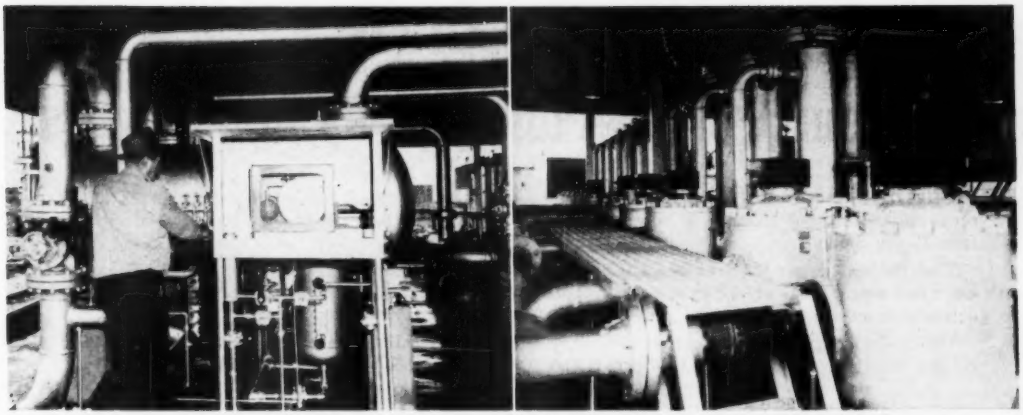


Left: Batch testing by sight glass at left of the gravity meter. Right: Displacement meters for incoming and outgoing shipments

for shipment through its system to Waco, Dallas, Fort Worth, and Austin.

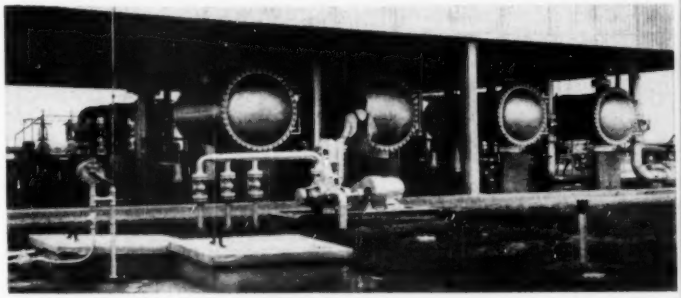
At the Hebert terminal, the large manifold built all aboveground is protected by a large building with open sides very suitable for Gulf Coast conditions. The other main features of the terminal are the pump station itself, office building, warehouse, garage, and aboveground filling lines to the tanks with expansion joints to compensate for any movement and tankage.

Minimizing Commingling

To hold commingling of products to a minimum, the headers in the manifold are designed with extremely short risers and with a three-way plug valve dividing each header keeping the gasoline on one end, and the kerosine and diesel fuels on the other end. Positive shutoff is assured of products due to the unique design of the manifold whereby it is possible to close two valves against the diesel-kerosine side of the manifold and the gasoline side of the manifold on all headers.

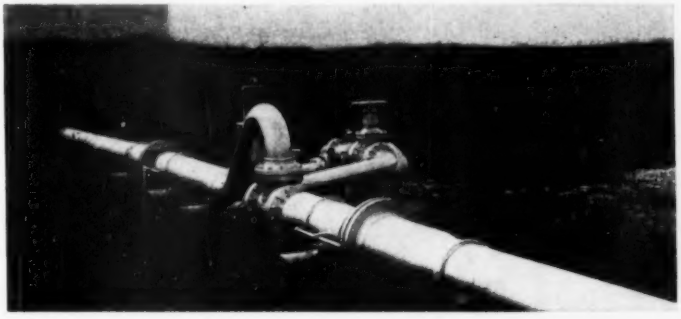
The manifolds, hay tanks, filters, gravitometers, chemical injector, and meters are all under a steel-frame structure covered with corrugated asbestos. This building was equipped with hoists to facilitate the initial installation of the manifold and is now used in cleaning filters and hay tanks, and removing meters when necessary. Under this shelter all batch cuts are made and all receipts and pumpings are metered for checks on the incoming and outgoing lines. The meters to date have given excellent service and have handled their design expectations perfectly. All meters in the system are calibrated by the master-method, the master meter itself being calibrated with a calibration tank.

Meters and pumps at all installations are protected by hay tanks or settling tanks in series with filters. These pieces of equipment are cleaned when the pressure drop across them reaches a predetermined point. The schedule for cleaning this equipment has been revised from time to time as the system is cleaned up. When the system was first put into operation large particles of mill scale were continually coming in and were removed from the stream by the hay tanks and settling tanks. Now only a fine powdery substance like rouge is left in the system and this is gradually decreasing to the point where the cleaning of hay tanks is not necessary even after a million barrels of products have passed through them. It is hoped that by the continued use of an inhibitor that the system will eventually be a 100 per cent free from internal corrosion.



Hay tanks at manifold

The main pump-station building is a steel-frame, flat-roofed building with corrugated-asbestos siding. The interior is divided into four rooms which are pressurized and ventilated to prevent gasoline fumes from entering the motor and electrical control room, as none of the electrical



Centrifugal suction pump with three-way check valve

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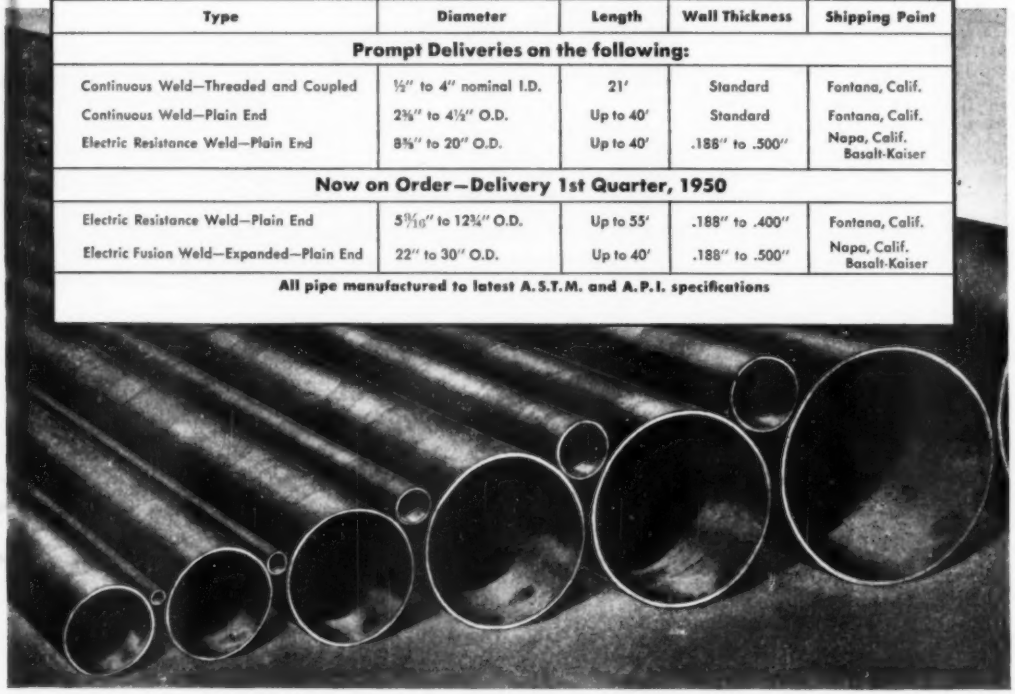

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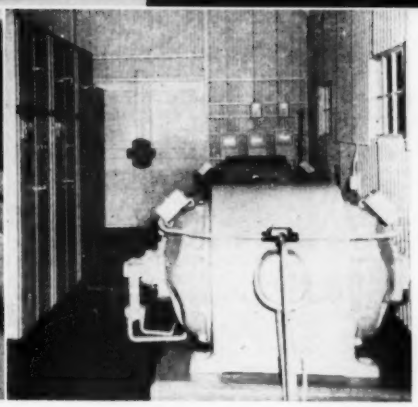


Extreme left: Expansion joints on lines to tankage. Dark places show extent of expansion

Left: Two 400-hp. motors and switchboard

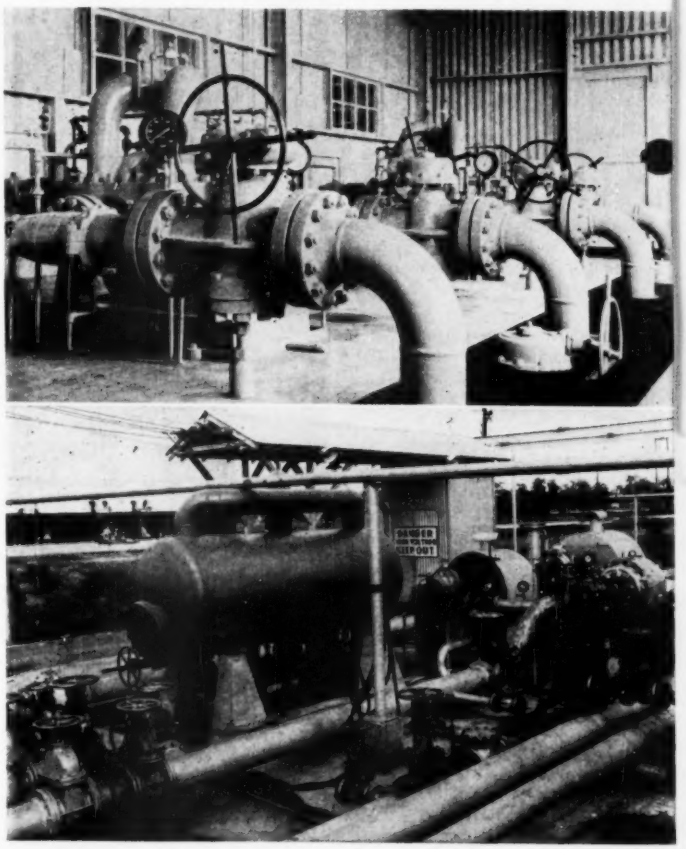
equipment is explosionproof. In the pump room are two four-stage centrifugal pumps with space left for the installation of another unit when needed. The piping to the pumps enters the station through a concrete trench covered with an open-type, nonskid grating. The suction and discharge feeders to the pump were made as short as possible to prevent unnecessary mixing when a batch charge enters the station. The motor-driven pumps have mechanical seals which are cooled by filtered products preventing any dirt or scale from coming in contact with moving surfaces of the seals and throttling bushings. To date there has been no trouble from the seals; however, the discharge pressure of the pumps has not exceeded 790 psi., and it is at pressures higher than this that other products lines have experienced trouble.

The flow up the main line is regulated with a pressure controller which also controls the suction pressure to the pumps. Safety features in the station include mercoid switches which will shut the station down in case of too high pressure on the main line, too high discharge pressure on the pump, and complete failure of suction pressure. There are also warning horns which blow when the air supply fails which operate the pressure controller and when the motor bearings or windings become overheated.

Products that can be handled are premium, house brand, special blending stock, kerosine, and diesel fuel. The various products received at Hebert are segregated in tankage for this purpose before they are pumped up the main line to Houston and Hearne. Three methods are used to catch a batch change when it arrives: (1) sight glass, (2) gravity meter, (3) hydrometer.

With the sight-glass method, batch changes may be identified more readily when the products are of two distinct colors. The sight-glass installation consists of three glass bulbs which are manifolded so that products can flow through any one of them. The method used is to fill one bulb with the product being received just before the interface is expected. This bulb is then shut off and the product is permitted to flow through the next bulb. When this bulb begins to change color the interface has arrived and at the proper time as has been determined by previous experience the batch is cut in the center of the interface. After the beginning of the interface has arrived the second bulb is turned off and the product allowed to flow through the third bulb. This bulb is observed to note the further change of color to be sure that it was not a slug of off-color product that was observed initially and is kept flowing until the color as specified by the dispatcher has been obtained.

The recording gravitometers or hydrometers are used when the prod-



Top: Two three-stage double volute centrifugal pumps. Bottom: Scale trap to protect moving products from Beaumont refinery tank farm

ucts are of the same color but have different gravities. A small rotometer is used on the gravitometer to assure the operators that the correct rate of flow is maintained through the instrument so that the proper time lag can be considered in making batch cuts. When the adjoining products in the line are of similar color and approximate gravity a dye plug is injected between the two batches at the initial station so that each product can be cut properly and handled separately from beginning to end. The dispatcher has complete control and instructs on batch cutting.

After the products are received into the Hebert station tanks they are pumped out of the tank through the same tank farm line, or in other words, a common suction and filling line is used. This is done with the use of three-way check valves which permit the product to flow into the tank without going through the pump and permits the operator to pump out the tank by remote push-button control in the main-station motor and control room without having to operate valves on the tank farm. There are also start and stop buttons at the pumps to be used if trouble should develop in any unit or in the control circuits. All lines on the tank farm are aboveground supported by 4-in. pipe supports. These exposed lines have expansion joints to allow for the expansion and contraction due to temperature changes. In all, there are 30 expansion joints on these lines which were all made in the Magnolia Pipe Line Co.'s Corsicana shop.

During the design stages of this products transportation system there was considerable concern over the internal cleanness of the lines when operations began. To keep as much dirt as possible out of the 12-in. main line from Hebert to Hearne while under construction, the pipe was purchased with metal light-weight caps on each end. These caps were not removed until the joints of pipe were ready to be lined up and the stringer head run. This kept out a considerable amount of dirt but some dirt still got in when the pipe was strung through rice fields, river bottoms, and road crossings.

The line was laid in sections of from 10 to 12 miles each. As each section was completed it was swabbed out with a rubber pig pushed by air through the entire section. The swabbing removed some mill scale and dirt and as the pig had a sizer on the front, it removed any welding icicles that might be projecting into the line. As soon as the pig was blown out of each section, that section was bottled up and pressured to 200 lb. of air. This was allowed to stand for 24 hours to see if that section had any leaks. No leaks were evident under these tests. After each section of the line was completed, swabbed and air tested, 1,200-psi. working-pressure block gates were installed on each section. When the line was completed each section was tested hydraulically at 800 psi. using kerosine for the tests. When the pressure tests were completed the line was washed its entire length with kerosine and wire-brush pigs to remove any remaining trash or dirt. The kerosine used to wash Magnolia's line was also used in cleaning Texas Pipe Line Co.'s lines from Hearne to Dallas and from Hearne to Austin.

As soon as the system started regular operations, a scraper program was started using bypass-type pigs with two steel-wire brushes and three rubbers. This program was continued for about 8 months at which time a very little amount of mill scale was coming in with each scraper; however, the product in front of the scrapers was still cloudy. We felt at this time that the line was clean enough to start using an inhibitor. It was then that an inhibitor program was started using sodium chromate as the inhibitor. Since that time the internal condition of the line has gradually improved as is indicated by the clearing up of the cloudiness of the product in front of each scraper. The line now seems to be in a very good condition so the running of pigs with wire brushes has been discontinued and only pigs with rubbers are now used to swab the line. The C factor even with reduced pump rates has remained close to 160.

THE ANSWER IS ALWAYS THE SAME

Cleaning and Servicing of present pipe lines is more economical than replacement operations

Photo A — Section of 4,645' line of 8" steel pipe before cleaning by rotary method.

Photo B — Section of 1,020' line of 14" cast iron pipe before cleaning. Note that pipe is completely clogged.

Photos above illustrate pipe line conditions encountered by the Pittsburgh Pipe Cleaner Company in one cleaning operation for a mid-west industrial firm. Note that pipe in photo A is almost completely plugged, while photo B pictures a pipe line that had been sealed with incrustations.

Successful cleaning of these long runs of pipe line again point to the fact that even in cleaning operations as extreme as those shown above, new construction and replacement costs continue higher in comparison with cleaning and servicing existing pipe line systems.

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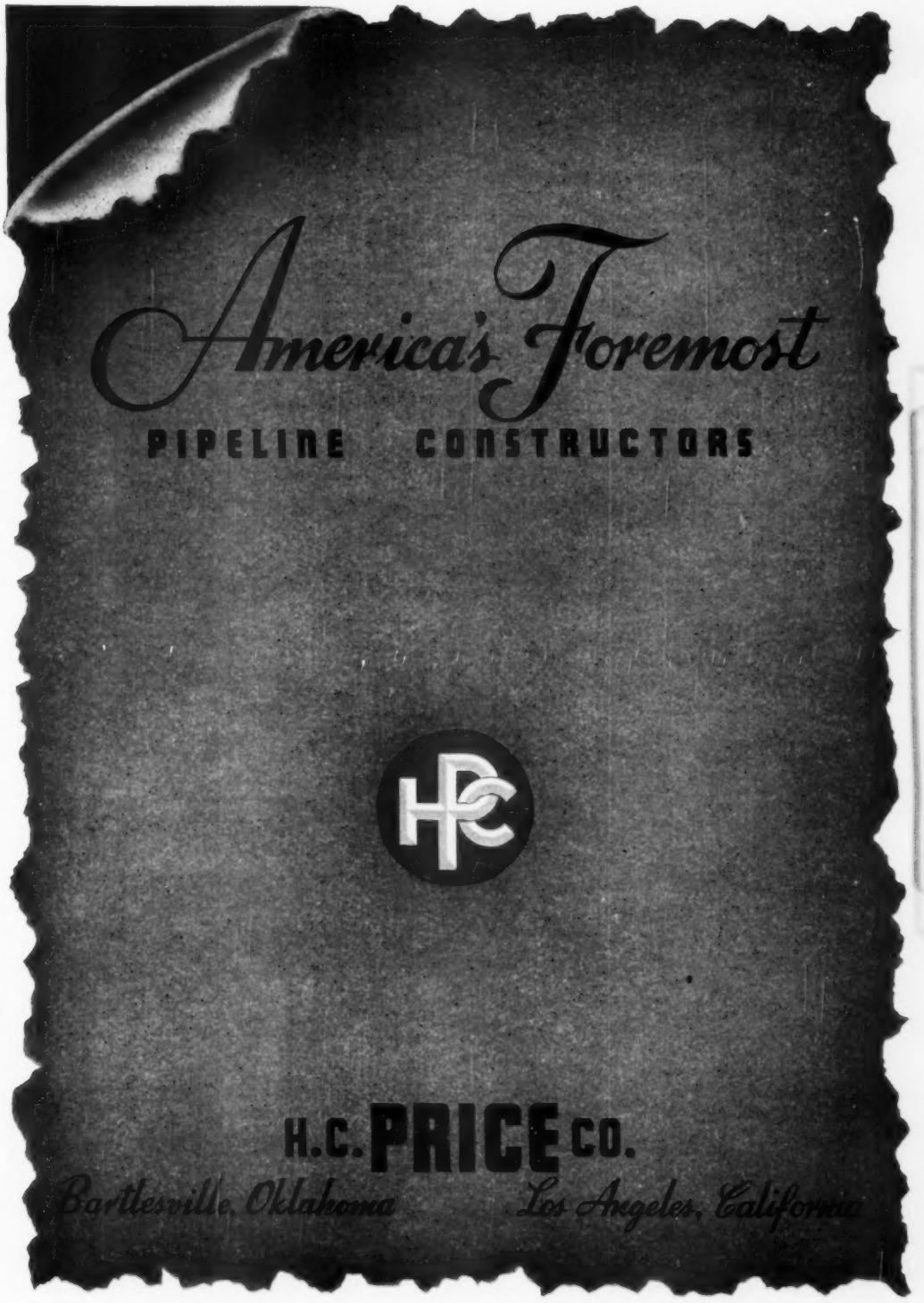
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Features in the Design of Large Pipe-Line Pumps

by Carlo Bartelero*

OIL in prewar pipe-line systems was moved mostly by the positive-displacement type of pump. Stations were located in the neighborhood of 20 to 35 miles apart, depending on terrain and other design factors. A large part of the crude oil going to the East Coast at that time was transported by tankers, which was more economical than shipment via the pipe lines then in existence.

It was not until Germany declared war on the United States that the project of large-diameter pipe lines was considered. The crippling of our tanker fleet in the Caribbean Sea, Gulf of Mexico, and off the Atlantic Coast resulted in the construction of the Little Inch and Big Inch lines which were started early in 1938.

It was not until these lines were in operation that the economy of large-diameter lines was established. Centrifugal pumps were used for both of these lines. The Little Inch line, 20 in. in diameter, was equipped with 10-in. single-stage pumps in series, three to a station, operating at 3,600 r.p.m. with some stations more than 70 miles apart. For this diameter line the centrifugal pump approached the performance efficiency of the positive-displacement pump and its first cost and maintenance, as well as the space required for housing, were less. Increased distances between stations resulted in fewer stations on a line, materially reducing operating costs.

New Basin-Ozark Pipe Lines

When the Basin-Ozark Pipe Line System was planned, the preliminary layout incorporated pumps similar in design to those installed on the Little Inch line. Due to varying conditions along the line, three pipe sizes, 20, 22, and 24-in., were employed. Design conditions specified an initial capacity of 150,000 gal. per day at approximately 800 psi. with an ultimate capacity of 24,500. Maximum capacity was to be obtained by construction of intermediate stations.

Pumps for the Basin line and Ozark line are similar. Except for the piping arrangement and minor design and metallurgy changes, there is little difference in the pumps for each section of the line. The pumps furnished by United Centrifugal pumps for the Basin-Ozark line were built in Oakland, Cal.

The intent of this paper is to outline some of the principal features, involved in design and operation of large pipe-line pumps, with a comparison of 1,770-r.p.m. against 3,570-r.p.m. pumps in the capacities hereafter referred to.

For low capacities the most widely used equipment at present for high-pressure pipe-line service is the positive-displacement pump because of its efficiency, and the fact that it is easily connected to a variable-speed drive for variation in capacity. However, vertical multistage centrifugal pumps are invading this field. Currently there is an installation being made for three vertical pumps with different numbers of stages in each pump so that the pressure can be increased to affect the variation of capacity with a constant high-speed electric motor without a great loss in efficiency. The curve Fig. 1 shows the operation of these three pumps,

*Chief engineer, United Iron Works, Oakland, Calif., presented before Pipe Liners Club of Tulsa, September 19.

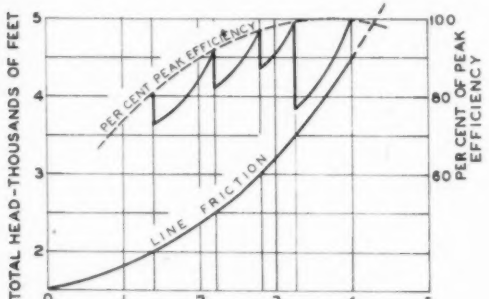

Fig. 1—Operation of three pumps in series: 6, 9, and 12-stage units

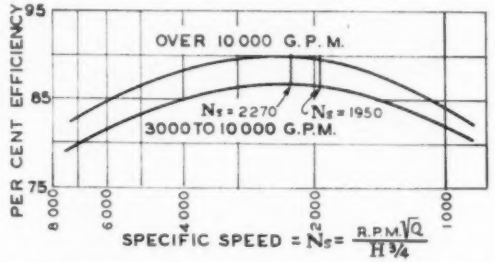

Fig. 2—Specific speed vs. efficiency curve. (From A. H. Church. published by John Wiley & Son)

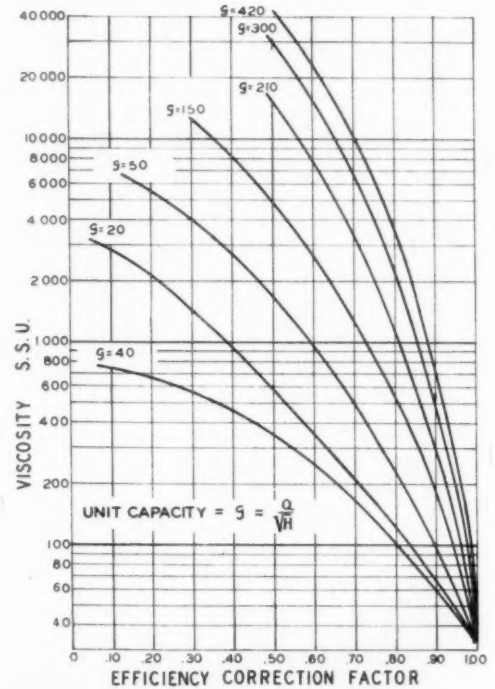

Fig. 3—Effects of viscosity on centrifugal pumps

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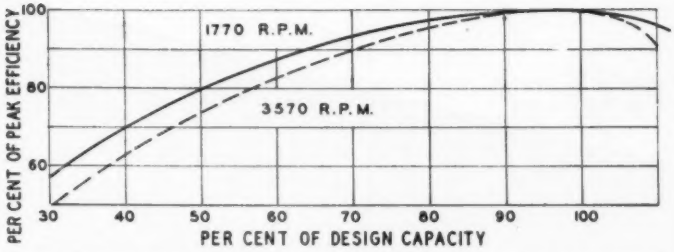

Fig. 4—Efficiency curves for two different pumps, plotted over per cent of design capacity versus per cent of peak efficiency

a 6-stage, a 9-stage, and a 12-stage unit. These pumps may be so operated that the number of stages used can be changed from 12, 15, 18, 21, and 27. The capacity on this particular size line can be varied from 25 per cent of full capacity to full capacity without excessive loss in pump efficiency. The pumps can operate at five points on the friction curve without loss in pump efficiency by throttling. When throttling is necessary between points the efficiency curve will take on the peak-and-valley form illustrated. The above shows what can be done with centrifugal pumps operating on small pipe lines.

For ranges from 350 to 4,500 g.p.m. the centrifugal pump at 3,570 r.p.m. is most generally used. These pumps are generally multistage for the low range and single stage in series for the higher range.

For the range of 4,500 to 8,000 g.p.m., which is the present-day capacity for large pipe-line design, the 1,770 r.p.m. must be thoroughly investigated. This section of the paper is an attempt to show the factors involved and the merits for the 1,770-r.p.m. pump in this capacity range. For larger capacities further investigation should be made.

The major requirement for pipeline pumps is high efficiency over a long range of time without excessive cost and wear. This is the reason why various types of pumping equipment are used in pipe-line service.

In order to make a comparison between 1,770 and 3,570-r.p.m. pumps we will assume the following conditions: The pumps are electric-motor drive; the pressure per station is set at 810 lb.; the required capacity 200,000 bbl. per day or 5,850 g.p.m.; the pumped material has a specific gravity of .86, and a viscosity between 70 and 150 S.S.U. Three pumps in series will be used per station. Each pump will have to develop 270 psi. pressure or 725 head. Horsepower required will be about 1,070.

From the standpoint of performance, the efficiency depends upon capactities, head and speed, all of which are included in the specific speed herein indicated as N_s. Specific speed is equal to $\frac{RPM \times \sqrt{GPM}}{H^{3/4}} = N_s$, is a dimensionless figure which indicates the pump proportion and not its size. For a given condition (head and capacity) the specific speed can be changed by either changing the r.p.m. or the number of stages used. By this means the pump designer can select the speed or number of stages for the best specific speed. This is not (from a practical standpoint) always advisable because it may require a great number of stages or a speed that is not readily obtainable.

To arrive at a size factor or the unit capacity of the pump the specific speed can be reduced to what is known as unit capacity ($g = \frac{Q}{\sqrt{H}}$) and unit speed ($n = \frac{\sqrt{RPM}}{H}$). Specific speed can now be shown as $n \times \sqrt{g}$. Unit capacity (g) will be used later to arrive at the viscosity effects upon the pump.

The three double-suction single-stage pumps at 3,570 r.p.m. will have a specific speed of 1,950. The three 1,770-r.p.m. two-stage single-suction pumps will have a specific speed of 1,650. For comparing the specific speeds, one of the two pumps must be converted into the other. Converting the 1,770-r.p.m. single-suction pump to a double-suction pump, means that the capacity is doubled but the head remains the same and the flow characteristics throughput the pump remains the same. By doing this the N_s for the two-stage pump becomes 2,270. We now have a direct comparison in specific speed between the two pumps, namely 2,270 for the 1,770-r,p.m. and 1,950 for the 3,570-r.p.m. pump.

To arrive at the relative difference in efficiency of the two pumps, the pump designer must review his curves on efficiency versus specific speed which most centrifugal-pump manufacturers have based on their own experience, tests, etc. These curves vary with capacities. Here we refer to the curve published by John Wiley & Son, Inc., and prepared by A. H. Church on the subject of Centrifugal Pumps and Blower. (Fig. 2). Reference is made to this curve because it has been given considerable publicity and it is typical of the centrifugal-pump manufacturers' curves. This curve indicates that the efficiency for the capacity range between 5,000 and 10,000 r.p.m. is higher for the specific speed of 2,270 than for 1,950. We can then expect a more efficient pump to be designed at 1,770 than at 3,500.

Comparing the viscosity effects on the 1,770-r.p.m. pump versus 3,570-r.p.m. pump, it is generally known that the larger the areas the less the viscosity effects upon the flow. Also, the slower the moving parts rotate, the less is the viscosity effect upon them. On this basis we must investigate the unit capacity (g) on both of these units to arrive at the effect of the viscosity. The unit capacity is a part of the specific speed, as mentioned above, which indicates the pump size and contains the two elements which are affected by the viscosity, i.e., capacity and head per stage. We have established the curves (Fig. 3) by plotting all the available data from tests on the effects of the viscosity upon centrifugal pumps based upon the unit capacity of the pump. This curve is shown as viscosity versus percentage in drop of efficiency for various unit capacities. The only similar curves published, to the writer's knowledge, are those on the effects of viscosity on centrifugal pumps based on unit capacity. These data are prepared by N. Titlow and published by Journal and Proceedings of London, Vol. 50, No. 4, February 1944. Titlow refers to "Z Maximum," which is the same unit as we call the unit capacity since it is the ratio of $\frac{GPM}{\sqrt{H}}$. In the case considered here the unit capacity is 307 for the 1,770-r.p.m. and 218 for the 3,570-r.p.m. pump. This curve indicates that for the 70 S.S.U. the difference in efficiency is about .75 per cent and for the 150 S.S.U. the difference is 1.8 per cent in favor of the 1,770-r.p.m. pump.

Comparing the expected shape of efficiency curve for the two pumps (see Fig. 4) the curve, as shown, can be made broader from the peak point (with given technical skill) at 1,770 r.p.m. than that at 3,570 r.p.m. This is due to the better suction conditions by the slower velocities of the impeller and through the pump case.

Comparing the suction effects of the 1,770-r.p.m. pump with the 3,570-r.p.m. pump we must assume that the impeller-eye area is equal in each case. We must investigate and compare the velocity at the outer diameter of the suction vane tip or impeller eye. In general, it can be said that the slower the suction vane velocity the more stable the suction. We will assume the velocity of the liquid into the eye at 23 ft. per sec-

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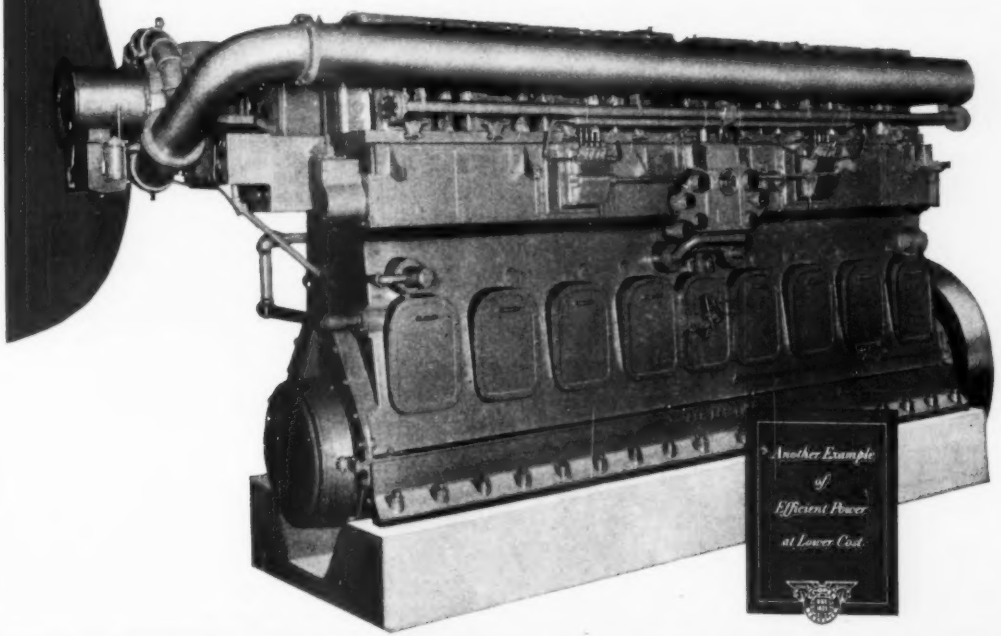

by **Cooper-Bessemer**

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ond in each case requiring a clear area of 81.6 sq. in. The shaft-sleeve diameter through the impeller eye is based on equal shaft stresses. For the 1,770-r.p.m. pump the shaft sleeve outside diameter at the impeller eye will be 4 in. and at the 3,570-r.p.m. pump the outside diameter of the shaft sleeve at the impeller eye will be 3¼ in. The impeller-eye diameter for a single-suction pump at 1,770 r.p.m. will be 11 in. and will have a rim velocity of 85 ft. per second. For the double-suction 3,570-r.p.m. pump the eye diameter will be 7⅛ in. and the rim velocity 123 ft. per second. Here again the 1,770-r.p.m. pump, having a velocity of only 71 per cent of the 3,570-r.p.m. pump is in favor. This will also be directly reflected in the velocity of the wearing rings which means that we have a slower rubbing velocity of the impeller rings on the slow-speed pump for the same velocity of the liquid flowing into the impeller eye. Also, the velocity of the shaft sleeve in the stuffing box for the packing or the mechanical seal will show even a greater difference or about 65 per cent slower in the slow-speed pump than that of the high-speed pump. This difference in velocity reflects directly upon the packing problem. In the capacity range which we are discussing it becomes questionable whether a mechanical seal will operate satisfactorily at 3,570 r.p.m. with shaft size required for these pumps.

To successfully operate mechanical seals in the pipe-line pump handling crude oils, we have found that it is necessary to filter out the solids which may be in the oil because they tend to settle in the stuffing box around the mechanical seal, due to the low velocity in this area. Deposits of solids pack the seal so that its function is impaired. Also, when handling crude oils we find that in most cases the crude oil deposits a carbon and salt on the sliding surfaces of the mechanical seal which again makes the seal ineffective after extended operation. To overcome this problem we recommend using a grease which is relatively insoluble in the crude oil to protect the sliding parts from being coated with carbon. This grease is injected into the mechanical seal by Zerk fittings.

We have found that the mechanical seal in crude-oil service operates longer without excessive wear if we can reduce the pressure below 300 psi. Therefore, in pipe-line service we equip the pumps with pressure breakdown bushings in the stuffing box to reduce the pressure on the mechanical seal. There are several ways of accomplishing this with filtered oil. The crude oil is taken from the discharge nozzle or from a small pump driven from the shaft of main pump through a packed filter, then the pressure is reduced by a pressure regulator to within 15 psi. of the pressure that is at the end of the throttle bushing. The filtered oil and the oil through the throttle bushing flows into a common header to the suction manifold of the pump station. By this method pressure in the mechanical seal can be regulated by controlling pressure in the return line.

At present the operation of the mechanical seal in pipe-line pumps has met with fair success. However, in the near future we believe that the mechanical seal will be used to a greater extent after more experience has been gained by both the manufacturer and the user. The mechanical seal is a precision device and, if properly operated and protected, will give satisfactory service.

Mechanically, the pumps of the capacity in question can be designed comparable with each other but from the maintenance viewpoint we should not overlook the fact that there is a great advantage in the slower-moving rotating parts of the impeller wear rings and stuffing boxes. There is an advantage favoring the 1,770-r.p.m. pump in regard to the cost of the motor in this size. Also a lower electric surge is required in starting up the slow-speed motors. If the capacity of the transformer at the pump station is ample, the motor may be started directly across the line, saving the cost of reduced voltage starter. The electric surge for starting the motor is said to be about 25 per cent less in the 1,770-r.p.m. motor than that in the 3,570-r.p.m. motor.

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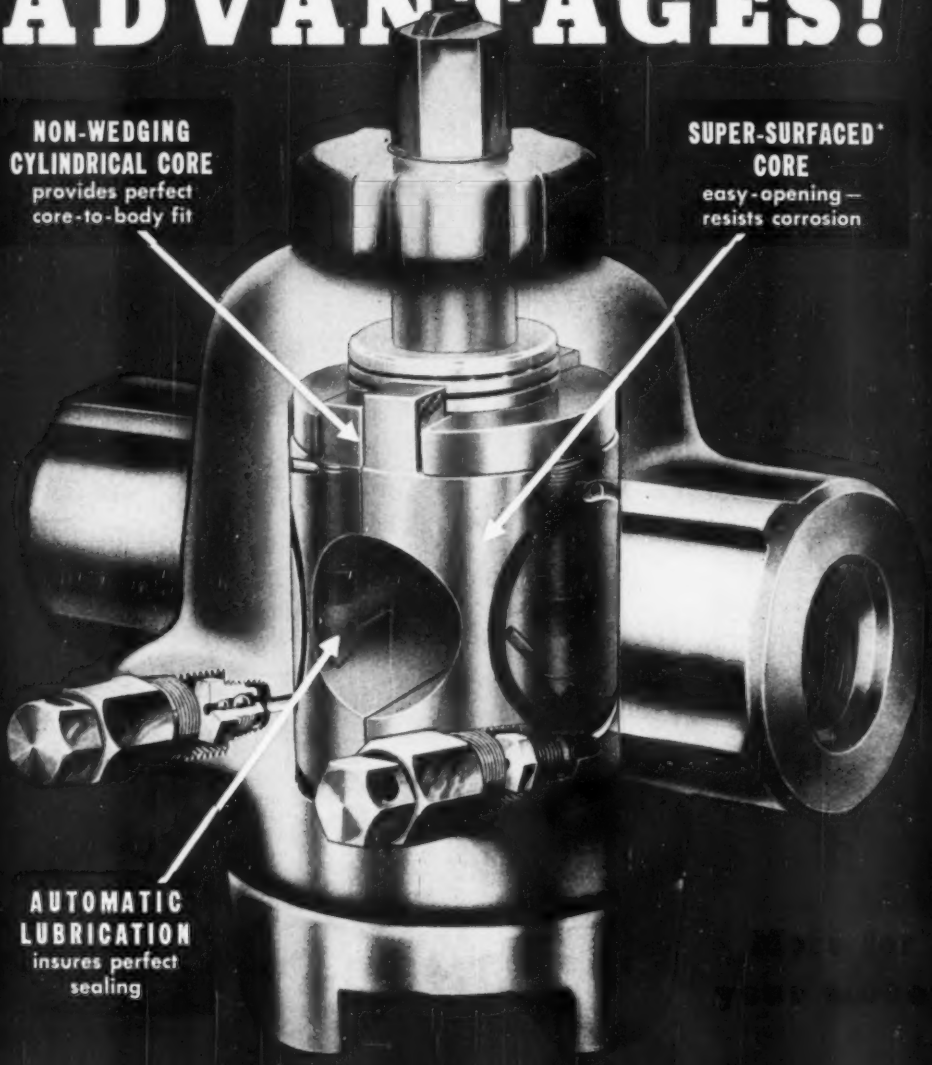

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Methods for Attaining HIGH Natural-Gas THROUGHPUT

By Maintaining Clean Pipe Lines

by D. K. Stephens

Expansible fluid-actuated pipe-line cleaning apparatus

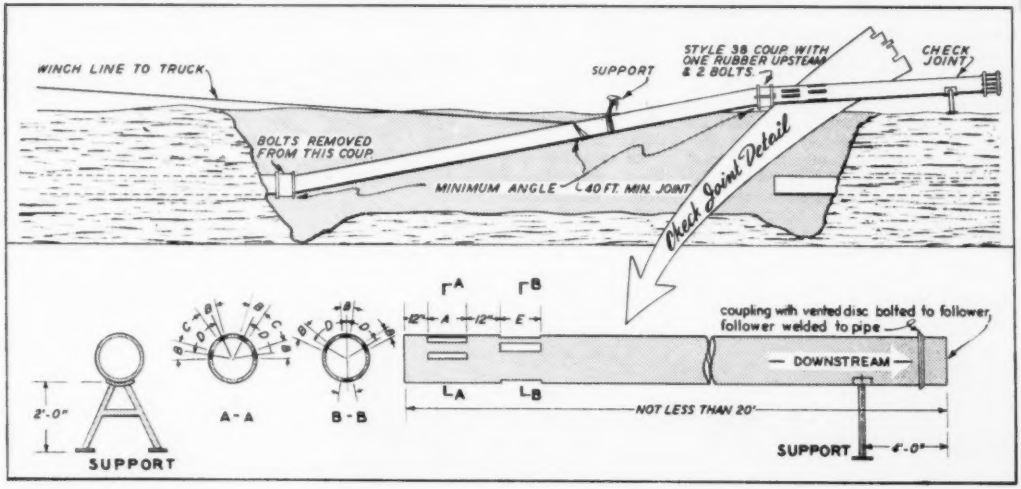
THE profitable nature of line-cleaning operations is indicated by comparisons with both operating expense and investment in transmission facilities. Increased efficiency has paid for the cost of cleaning in less than 2 months. Furthermore, (if cleaning were not done), for each 1 per cent decline in efficiency, 2½ miles of loop line of the same diameter would be required to restore a 100-mile section between compressor stations to the designed capacity. By stating this saving in terms of 24-in. loop at current costs, it will be seen that this amounts to a saving of approximately $40,000 for each mile of large-diameter loop line constructed; the cleaning cost is approximately only $200 per mile. In cases where additional throughput is not needed, savings in horsepower can be obtained as the result of increasing line efficiency by cleaning.

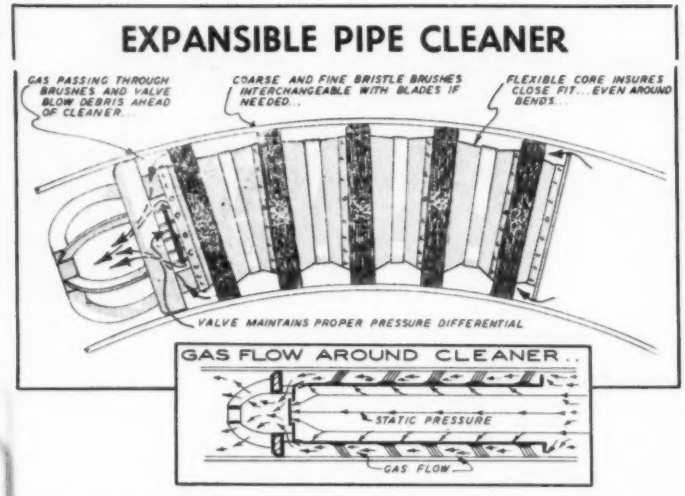
Effective removal of mill scale, rust, and other foreign material from the interior of new lines means less compressor-valve breakage. Wear on compressor cylinders and piston rings is reduced to a minimum.

It frequently happens that new lines operate 3 to 8 per cent lower than designed efficiency, entirely because the interior of the pipe has not been thoroughly cleaned. Thorough cleaning cannot be done by blowing alone. This can be accomplished only by a cleaning device designed for conditions in pipe lines.

Within the past year, approximately 500 miles of new and old lines have been cleaned with the newly developed expansible fluid-actuated pipe line cleaning apparatus. The advantage it has over the types of pigs built according to the usual principles is indicated by comparison of results on three sections cleaned in 1945 and 1946 with 1949 results at the same sections. The 1945-46 clean

Top: Arrangement of pipe for safe recovery of pig after blowing to clean the line. Bottom: Slot perforations in check joint for allowing gas to escape sufficiently for retrieving pig in this joint. "Check joint slot and spacing" table with this article gives dimensions for diagrams A-A and B-B applicable to pipe from 12 to 30 in. diameter




EXPANSIBLE PIPE CLEANER
GAS PASSING THROUGH BRUSHES AND VALVE BLOW DEBRIS AHEAD OF CLEANER.
COARSE AND FINE BRISTLE BRUSHES INTERCHANGEABLE WITH BLADES IF NEEDED...
FLEXIBLE CORE INSURES CLOSE FIT... EVEN AROUND BENDS...
VALVE MAINTAINS PROPER PRESSURE DIFFERENTIAL
GAS FLOW AROUND CLEANER...
STATIC PRESSURE
GAS FLOW

Diagrams showing how an expansible cleaner functions when it is moved by gas pressure through a pipe line

ing gave 86-89-89 per cent efficiency (average of 88 per cent), while the 1949 efficiency achieved at each of these three sections was 92 per cent. Average gain in efficiency was 4 per cent.

The expansible fluid-actuated pipe-cleaning apparatus consists essentially of an expansible rubber core built like a tire casing. It is capable of expanding 1½ in. from its collapsed size. When run at 10 to 45 psi. there is no injury to the core. The expanded core presses a series of circular wire brushes firmly against the pipe wall.

Maximum expansion of the core is controlled by the setting of a spring operated valve equipped with a sliding orifice plate. This valve at the head of the apparatus maintains the differential pressure of 5 to 10 psi. needed for exerting sufficient pressure on the top, bottom and sides of the pipe. The springs hold the valve closed up to the desired differential pressure before opening.

The cleaner functions in such a way that it completely avoids the loss in effectiveness which has been commonly experienced in the use of earlier-designed cleaners. The trouble encountered with the cleaners on which the brushes are fixed and not expansible is that the wear on the brushes, before the end of an 8 to 12-mile run, will leave much of the upper part of the pipe uncleaned. Also, the necessity for making that type cleaner short enough to go around bends of 10-ft. radius or more, the brush surface on the cleaner has to be reduced.

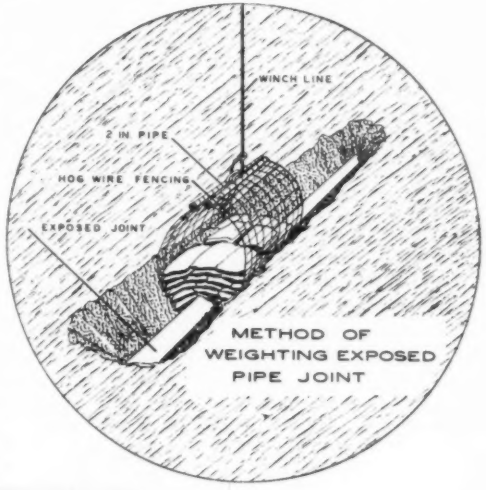
In the 500 miles of running the apparatus this year, it has passed through bends of all kinds including bends of 90° in 16-in. pipe. The cleaner probably makes several rotations in the pipe during a normal run; however, this rotation is not necessary for efficient cleaning in this type of apparatus. Better cleaning, it has been observed, can be done at reduced pressures.

In cleaning new lines immediately after construction and before they are put in service, a cleaner may be installed, when construction starts, immediately downstream from the first gate valve or starting point. The pipe can then be welded or permanently coupled and the ditch backfilled.

In case cleaners are not available at the start of construction, the joint can be left out of the line at the point where the cleaner is to be inserted. Or the line can be parted and raised for insertion of the cleaner later.

When construction for a solid welded line has progressed to within 100 ft. of the next gate valve, a joint of pipe is left out of the line to facilitate blowing out the scraper. After the next gate valve has been set, the procedure is repeated in the next section with the installation of another cleaner, etc.

(Continued on page 325)



Above: Removal of sacked dirt, for weighting pipe, is facilitated by use of wire sling.

Left: Gas and dust escaping from slot perforations when pig is being caught in check joints

D. K. Stephens, superintendent of pipe lines, Panhandle Eastern Pipe Line Co., commenced his work with the company's system in connection with construction operations. Subsequently he served as division superintendent until advancement to his present position in 1938.

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Williams Brothers have built more than 35,000 miles of pipe lines on three continents in the past 34 years. In executing these contracts, swamps, rivers, deserts and mountains have been conquered in all seasons and climates under all field conditions and each construction job was successfully completed.

Williams Brothers are ready, willing and able to build your pipe line anywhere on earth.

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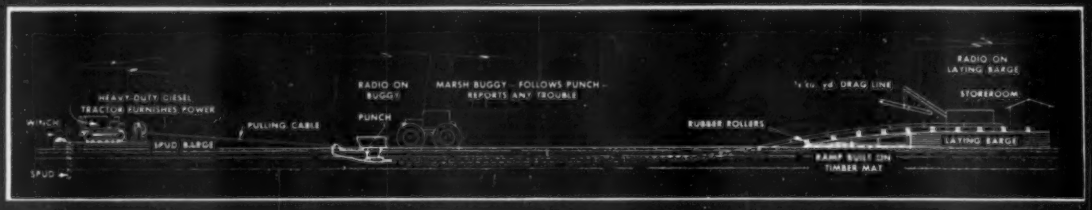
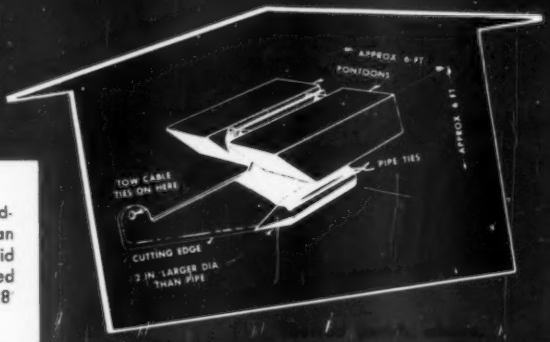
THIS NEW SHERROD PIPELAYING METHOD...



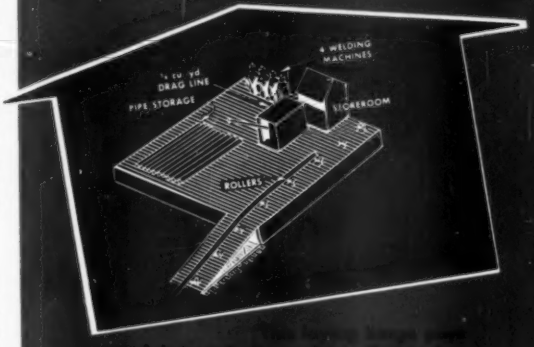
LICKS LOUISIANA MARSH, RIVER CROSSING JOB FOR THE TEXAS CO.



The Texas Co. had 44,500′ of three, four and six-inch Schedule 160 pipe to be laid for high pressure lines in the Bateman Lake Field . . . really a tough job, since pipe had to be laid through Southern Louisiana's marshy bayou country. Added to that, project included five canal crossings and a 1428′ crossing of the 100′ deep Atchafalaya River.

ATCHAFALAYA CROSSED IN 33 MINUTES

Contractor on the job, Buddy Sherrod, Inc., used new Sherrod Punch-Pull pipelaying method, to hang up such production records as 1670′ of three-inch pipe laid through marsh land in one day; 5,250′ laid in five days; and the Atchafalaya River crossing—1428′ wide and 100′ deep—completed just 33 minutes after the pipe section had been fabricated and tested!



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Besides production records that slash man-hour and operational costs, Sherrod's new method of laying pipe by pulling it underground eliminates high cost of pipe stringing, ditching, diking, and back-filling. Cuts out excessive equipment charges too, since only three major pieces are required. Eliminating all these high cost factors means a big reduction in job costs—a saving passed on to you as client.

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CONROE, TEXAS

Design of Large-Capacity DEHYDRATION PLANTS For Products Pipe Lines

by H. E. Fisher

THE Standard Oil Co. (Ind.), products pipe-line department, will construct a 50,000-bbl. per day dehydration plant early next year at the initial pump station on its products pipe line from Whiting, Ind., to Moorhead, Minn. This line, which serves five large pipe-line terminals, was completed in early 1947. Operating experience in the last 2 years has proved the necessity and advisability of utilizing dehydration on this line not only as the fundamental method for control of internal pipe-line corrosion, but to eliminate in so far as possible many problems relating to the delivery of products uncontaminated by water to pipe-line terminals.

Simultaneous with the construction of the Whiting plant, Standard Oil Co. as agents for Wyco Pipe Line Co., will also build a 20,000-bbl.-per-day dehydration plant at Wyco's Strouds station (near Casper, Wyo.), the initial high-pressure station on the products line to Cheyenne, Wyo., and Denver.

Although the principle of dehydration of petroleum products is relatively simple, viz., passing the product over a suitable desiccant embedded in pressure vessels to remove free and adsorbed water, the various methods of regenerating the desiccant bed by application of heat present many interesting problems in process design. The unavailability of engineering and cost data on large-capacity dehydration plants for products pipe-line systems necessitated a thorough study of the various mediums and methods of regeneration in order to determine the optimum type of plants to construct at the above locations.

The author is chief engineer of the Standard Oil Co. (Ind.), products pipe-line department, who in addition to handling all engineering and construction on Standard Oil Co. products lines acts in a similar capacity as agent for Wyco Pipe Line Co. He has had 17 years' pipe-line experience having started in field engineering work for Stanolind Pipe Line Co. in 1932. After serving in various field jobs in both engineering and construction work, he was transferred to the Tulsa engineering department. In 1939 he was transferred to the general superintendent's staff for special assignments and ultimately was placed in charge of cost estimating. When the parent company started expansion plans for its new products system, he was transferred to the home office at Chicago in 1942. He obtained his college training at University of Oklahoma. At present he is vice chairman of the A.P.I. Committee on Pipe-Line Technology and chairman of the Subcommittee on Pipe-Line Construction Practices.

TABLE I—COMPARATIVE COSTS 50,000-BBL.-PER-DAY DEHYDRATION PLANT USING STEAM, GAS, OR NAPHTHA CYCLES FOR REGENERATION INVESTMENT AND OPERATING EXPENSE

	Steam		Gas	Nahptha*	
Regenerating medium—	Steam system	Closed steam coil system	Gas system	Steam heated system	Gas heated system
Total plant investment†	$148,000	$164,000	$175,000	$162,000	$173,000
Operating expense—cost per 1,000 bbl.:†					
Steam (70 cents per 1,000 lb.)	$1.260	$0.246		$0.164	
Electric power (0.35 cent per kw.-hr.)	0.093	0.093	$0.169	0.115	$0.115
Gas (57 cents per 1,000 cu. ft.)	...	...	0.192	...	0.181
Maintenance	0.049	0.060	0.093	0.093	0.093
Direct operating expense	$1.402	$0.399	$0.454	$0.372	$0.389
Advalorem taxes	0.122	0.135	0.144	0.133	0.142
Depreciation	0.405	0.450	0.480	0.445	0.474
Total cost per 1,000 bbl.	$1.929	$0.984	$1.078	‡$0.950	‡$1.005

*The term "naphtha" refers to any hydrocarbon with the specifications set forth in the article. †Based on steam, gas, and electric power being purchased on site at indicated rates and operating labor being available from station personnel at no additional cost. ‡Assumes that regenerating medium and holdup stock could be reclaimed as a merchantable product

Various Methods Considered

Preliminary investigations indicated that the principal regenerating mediums to be considered for detail study were steam, gas, and naphtha.* Using these three mediums, the following methods of regenerating desiccant beds were investigated:

1. A dehydration plant using an open steam system whereby superheated steam at 400° F. from 5 to 100 psi. is passed direct through the desiccant until the bed is regenerated.

2. A dehydration plant using a closed-coil steam system whereby steam at 150 psi. is passed through coils embedded in the desiccant until the bed is regenerated.

3. A dehydration plant using an

*The term "naphtha" as used here and elsewhere in this article refers to a highly saturated hydrocarbon that exists in a vapor state between 350° to 500° F. at some positive pressure below 100 psi. and exists as a liquid at temperatures in the vicinity of 100° F. at 100 psi. From these specifications it is possible and expedient to use as the desiccant-regenerating medium gasoline or other petroleum products customarily handled through product pipelines.

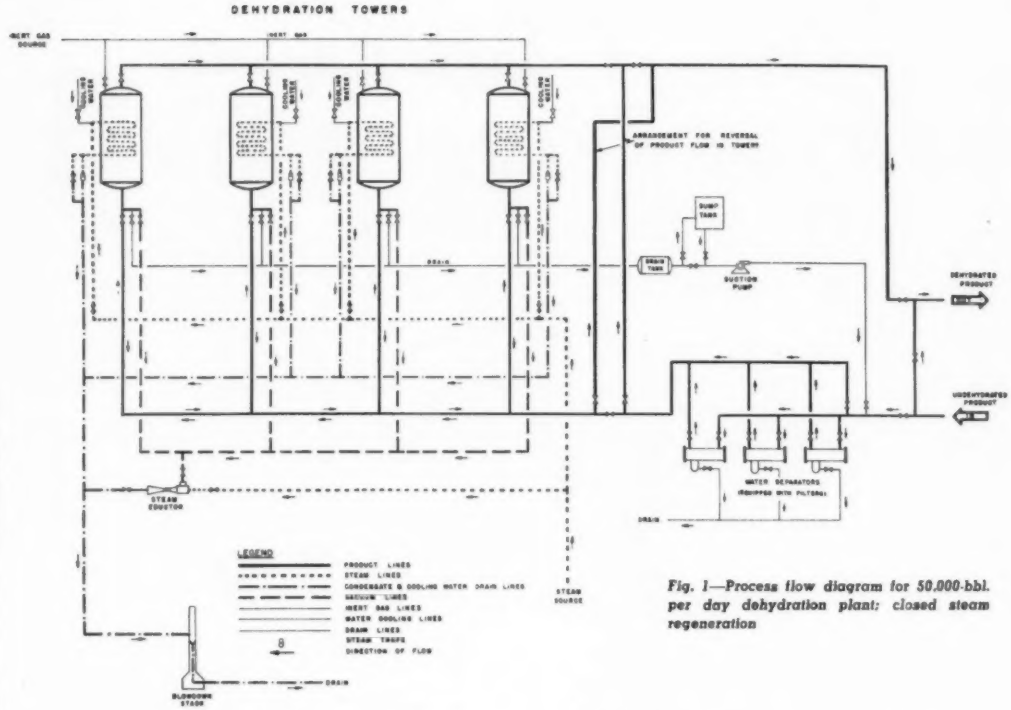

Fig. 1—Process flow diagram for 50,000-bbl. per day dehydration plant: closed steam regeneration

open gas system whereby natural gas at 500° F. from 5 to 100 psi. is recycled direct through the desiccant until the bed is regenerated.

4. A dehydration plant using naphtha vapors whereby liquid naphtha* is vaporized in a steam-heated exchanger and the vapors at 350° to 500° F. from 5 to 100 psi. recycled direct through the desiccant until the bed is regenerated.

5. A dehydration plant using naphtha vapors whereby liquid naphtha* is vaporized in a gas-fired heater and the vapors at 350° to 500° F. from 5 to 100 psi. recycled direct through the desiccant until the bed is regenerated.

Similarity of Methods

The location and interconnection of the dehydration plant with the other pipe-line pump-station facilities are practically the same for all five types of plants studied. The incoming delivery lines from the shipper or refinery should be connected to the dehydration-plant facilities immediately after connection with the incoming station manifold and before passing through the delivery meters. It is important both from a meter maintenance and stock accounting standpoint to arrange the piping to provide for metering after the product has been dehydrated. The plant layout in relation to the pump station depends on the location of steam, gas, electric power, water, sewer, and drain lines; however, every effort should be made to locate the plant immediately adjacent to other station facilities not only to keep down operating and maintenance labor, but to hold product commingling and drain-up time to a minimum.

All of the plans provide for the incoming stream to the plant first passing through combination water separators equipped with filter packs. Experience of other pipe-line operators indicates that these separators are good insurance against the possibility of excessive free water in the stream entering the plant. It is believed that practically all of the free water in the stream will be removed together with some sediment.

The plans also provide for reversing the product flow up or down in the vertical dehydration towers as well as bypass piping for use, if desired, during a product change. The dehydration towers are sized to operate in pairs with orifice fittings on each to regulate the flow between the two towers on stream.

Open-Steam Method of Regeneration

A plant utilizing the open-steam method of regenerating the desiccant beds is the simplest in design and cheapest in initial investment, but, unfortunately, high in operating cost primarily because of inefficient heating. The towers for this type plant consist of vertical cylindrical pressure vessels with the desiccant supported by stainless-steel plates and screens and equipped with thermocouples, relief valves, instrument lines, etc.

To regenerate the bed in a tower out of service, it is first necessary to drain the holdup stock remaining in the desiccant into a slop line after which superheated steam at 400° F. from 5 to 100 psi. is passed downward through the bed into a blowdown line, the exhaust steam being vented to the atmosphere through a blowdown stack. The downward flow of steam is continued until the desiccant bed reaches approximately 375° F. Following the steam phase of the regeneration cycle, a 26-in. vacuum is applied to the bed by a steam-jet eductor to remove the remaining steam and product vapors from the capillary spaces of the desiccant.

The tower is then purged with natural gas or any other suitable inert gas, with the exhaust going to the blowdown stack. After the tower is fully purged and the temperature of the bed lowered, it is pressurized with about 5 psi. of gas and isolated for future service. The desiccant bed is cooled by the gas purge and the time lag before going back on stream. When the regenerated tower is put on stream, it is first slowly flooded

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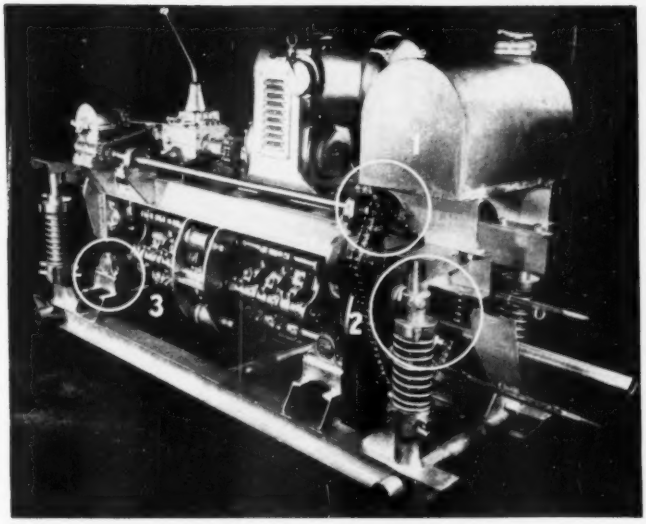

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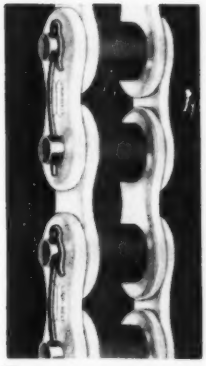

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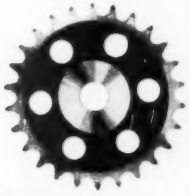

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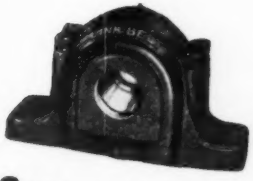

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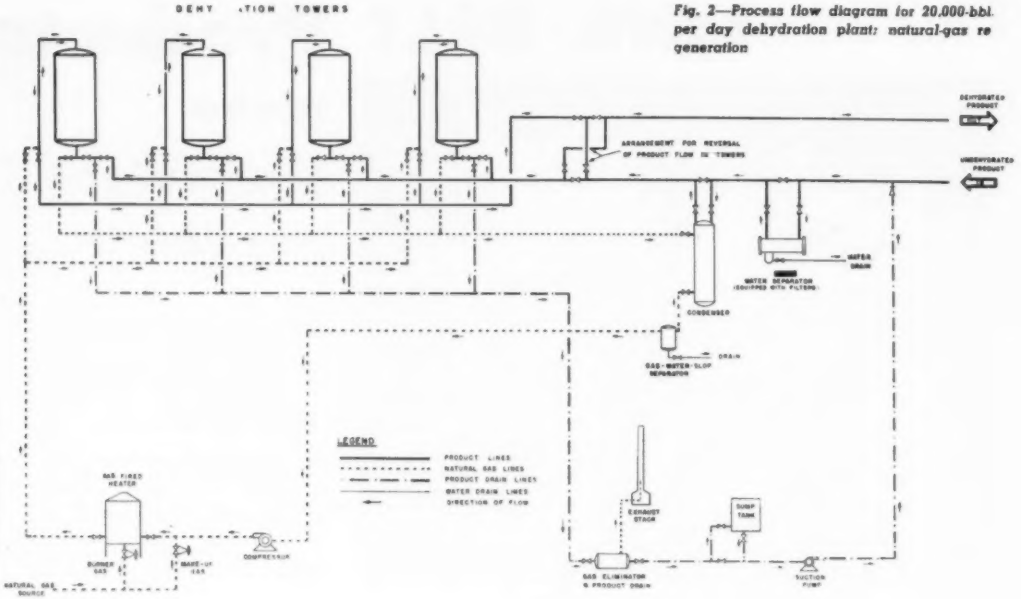

Fig. 2—Process flow diagram for 20,000-bbl. per day dehydration plant: natural-gas regeneration

with pipe-line stock until all the gas is vented to the blowdown stack.

It should be noted that in this method, superheated steam must be used and that the heat transferred to the bed is only the superheat available; consequently, a large percentage of the B.t.u.'s available in the steam is wasted. This results in high costs for steam as reflected in the operating expense shown in Table 1. This method also necessitates the regenerating medium coming into direct contact with the holdup stock and desiccant.

Closed Steam vs. Open-Steam Method

The primary difference between the closed-steam-coil method of regeneration and the open-steam method is the utilization of steam coils embedded in the desiccant; whereas, under the latter method steam is passed directly into the desiccant bed. The coil system offers all of the advantages of heating the desiccant by steam but none of the disadvantages and inefficiencies of the open-steam method.

The initial investment and maintenance cost of the closed coil system are slightly higher due to the embedded coils but the efficiency, which is reflected in lower operating expense, offsets these higher costs. In addition, saturated or superheated steam may be used in the closed-coil system; whereas, under the open system superheated steam must be used. The closed system is more efficient because latent heat is transferred and consequently a large percentage of the total heat content in the steam is effective in the regenerating cycle.

The process design for a dehydration plant operating on the closed-steam-coil method of regeneration will be discussed later in the article, as this method was selected for the 50,000-bbl.-per-day plant to be constructed at Standard's Whiting station. Fig. 1 shows the general layout and flow diagram for a plant using this method of regeneration.

Regeneration with Gas

Although it was determined that the closed-steam-coil system would be the most economical for installation at Whiting, it was found that the Wyco 20,000-bbl.-per-day plant could be operated more economically on natural gas. This was due primarily to the lower rate for purchased gas and the unavailability of purchased steam at Strouds station. It would have been necessary to construct steam-generating facilities with the necessary controls and appurtenances in order to use steam at this location. Regeneration of the desiccant bed under the gas method is accomplished by recycling natural gas through the following sequence:

1. Admit natural gas at 80 psi. into the regenerating system.

2. Heat the regenerating gas in a gas-fired heater to 500° F.

3. Pass the hot gas directly through the desiccant, heating and stripping it of holdup stock and water, and carrying these as vapors into the gas cooler.

4. Cool the gas and vapors in a condenser.

5. Separate the gas from the holdup stock and water in a gas-slop water separator.

6. Compress the gas to recover any loss in pressure by use of a motor-driven compressor.

7. Pass the compressed gas into the gas-fired heater and repeat the sequence until the desiccant bed reaches 375° F.

When the tower is fully regenerated, the gas-fired heater is cut out of the sequence. Cooling of the bed is accomplished by continued recycling of the gas until the bed is brought down to approximately 115° F. The tower is then isolated; when ready for use, the tower is first slowly flooded with pipe-line product until all the gas is vented out the exhaust stack. Fig. 2 shows the general layout and flow diagram for this type of plant. It should be noted that under this method any available gas containing the required heating value could be used for fuel in the heater; however, gas such as waste refinery gas could not be used as the regenerating medium since it would contain too high a percentage of olefins and sulfur compounds. Small quantities of natural gas would have to be obtained as makeup for the regenerating cycle.

Obviously, it might be inadvisable for safety reasons to use an open gas-fired heater in a congested area on a pump station site where space limitations were at a premium. Such a heater would have to be located a safe distance from other station facilities.

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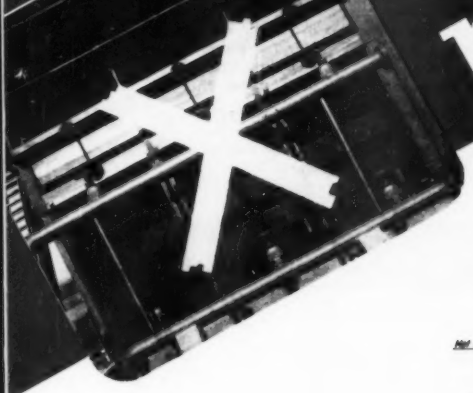

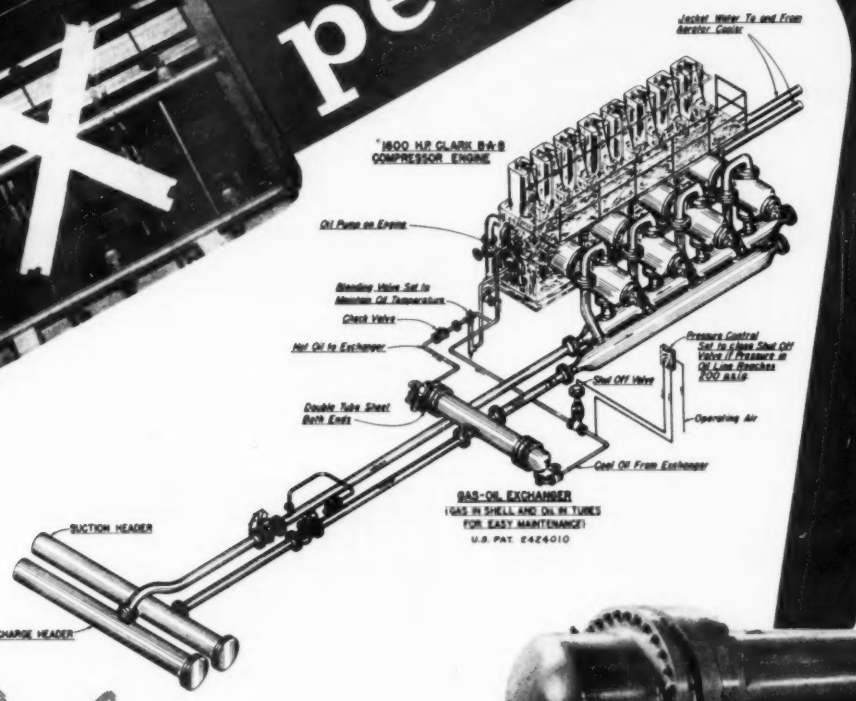
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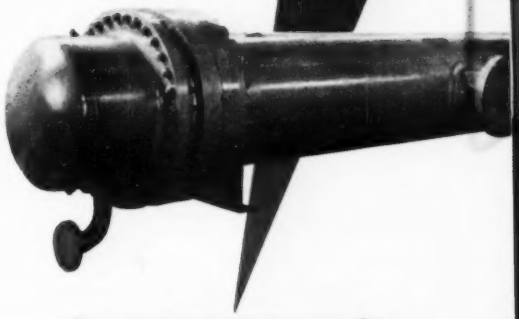

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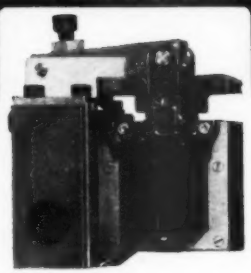

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Use of Naphtha Vapors for Regeneration

The design of a dehydration plant using naphtha vapors as the regenerating medium with either steam or gas-fired vapor generator is essentially the same. Regeneration of the desiccant bed is accomplished by recycling naphtha vapors through the following sequence:

1. Naphtha is heated and vaporized in a still by gravity circulation through a steam heat exchanger of a gas-fired heater, depending on the most economical heating medium.
2. The naphtha vapors are passed directly through the desiccant bed vaporizing the holdup stock and absorbed water.
3. The naphtha vapors, holdup stock, and water vapors are then condensed in a cooler.
4. The liquid mixture is then passed through a coalescing type of water separator where free water is removed and discharged into a sewer.
5. The separated naphtha and holdup mixture in a liquid state is then pumped into the still where it is revaporized and the cycle continued until the desiccant bed reaches a temperature of 350° F.

Cooling of the bed is accomplished in the same manner as previously described under the open-steam cycle.

It is obvious that the use of naphtha as a regenerating medium will present many contamination problems due to holdup stock in the towers. The amount of product retained by the desiccant will vary appreciably with the type of product being dehydrated; for example, oils will be retained in greater quantities than gasolines. It is estimated that the holdup stock will amount to 0.04 and 0.12 lb. of product per pound of desiccant for gasoline and furnace oil respectively.

Separation of the naphtha from the holdup stock will also present many problems since these components are miscible in all proportions and can only be accomplished effectively by distillation. Disposal of the naphtha and product mixture into pipe-line stock could possibly result in enough contamination in some cases to throw the products off specification.

The investment and operating expenses for a plant operating on naphtha vaporized by steam or gas heat are shown in Table 1. These figures indicate that at the utility rates used in the subject case there is no appreciable difference in direct operating expense between the two methods but a small difference in investment, the gas-fired system being the higher. It is important to note that the estimated operating expense assumes that the regenerating medium and holdup stock could be reclaimed as a merchantable product and added to the pipe line stream at no cost penalty. As pointed out above, this would not always be possible.

Closed Steam Method of Regeneration

The closed-steam-coil system of regeneration was selected for the Whiting dehydration plant primarily because of the following factors: (1) the estimated investment and operating expense are reasonable, (2) either saturated or superheated steam may be used, (3) simplicity of operations, (4) minimum safety hazards, (5) maintains the purity of the product being dehydrated as the regeneration medium is not in direct contact with the holdup stock or desiccant bed at any time.

Under this plan, finished products are received from the refinery at the pump-station site and are routed in sequence through the incoming manifold, booster pumps, dehydration plant, pipe-line meters, and ultimately into the main-line station pumps. Upon arrival of the undehydrated product at the dehydration plant, it is first passed through a pair of water separators equipped with filters, operating in parallel (25,000 bbl. per day each), to remove all free water and some suspended sediment. The product is then routed to a pair of the dehydration towers with the stream being equally divided between the towers by orifice flow-meter controls. The piping is so designed that either

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up or down flow of the undehydrated product can be accomplished through the towers. After the product is dehydrated it flows to the pipe-line meters and ultimately to the station pumps.

The tower on-stream time as well as the efficiency of the over-all dehydration plant will be checked periodically by analyzing the water content of product samples at various points in the dehydration cycle. The method of analysis will be basically the Fischer titration method provided with an electronic indicator for detecting the end point of the titration.

Our studies indicate that each tower will be cut off stream and regenerated after it has been in service a total of 24 hours during which period it has dehydrated 25,000 bbl. of product. Product remaining in the tower is drained to the sump tank. As the holdup stock and water drain from the tower, a small quantity of natural gas or any other suitable gas is admitted into the top of the dehydration tower to permit drainage.

Simultaneous with the draining of the towers, 150-psi. steam is fed into the embedded steam coils for heating the desiccant and operating the jet eductor to establish a vacuum on the tower. This vacuum is maintained throughout the regeneration period and until 26 in. of vacuum is obtained at the end of the cycle. Regeneration of the desiccant is complete when the minimum temperature of the bed reaches 350° F.

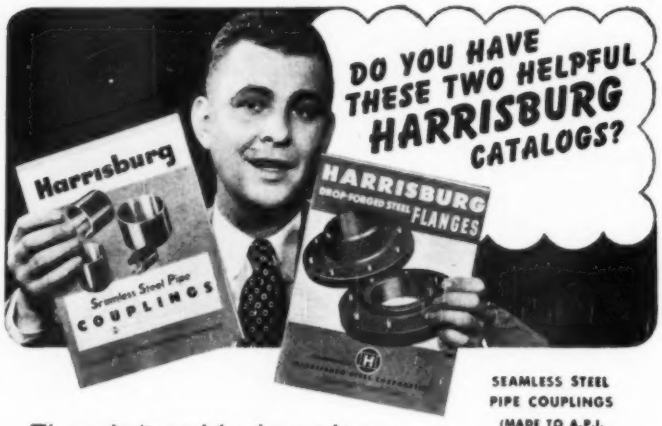
The condensate from the steam coils and exhaust steam from the eductor are vented at the blowdown stack. The vented steam is released to the atmosphere while the condensate is drained into a sewer line. Cooling of the bed may be accomplished by several methods; however, it is planned to cool the desiccant by running water through the steam coils.

Design Features for a Closed-Steam System

The process design for a 50,000-bbl.-per-day dehydration plant utilizing the closed-steam-coil system for regeneration involves many engineering considerations to arrive at the optimum type of equipment and controls to be installed. The dehydration towers for this size plant will be approximately 17 ft. high by 7 ft. in diameter and built to the A.P.I.-A.S.M.E. code for 100-psi. operating pressure with a bolted head to permit removal of the steam coils. They will be fully insulated and equipped with 20-in. manholes together with inlet and outlet connections, thermocouples, relief valves, and other appurtenances. The steam coils will be the fin type and evenly distributed throughout the desiccant bed. Each tower will hold approximately 7 tons of desiccant. Although there are many types of desiccant which can be used in this plant and others of comparable design, our studies and experience of others indicate activated alumina to be the most efficient and economical for this type of installation.

The desiccant bed proper will consist of 4-8 mesh activated alumina placed on top of an 18-in. layer of alumina balls. This 18-in. section will consist of 6-in. layers of alumina balls varying in size from ¾ to ¼ in. in diameter. The entire section plus the bed proper will rest on a 3 by 3 mesh stainless steel screen which will be supported by a large mesh extra heavy grating. The section of alumina balls is necessary to confine the alumina in the bed as well as to preclude the use of a fine-mesh screen which would become clogged. Alumina balls were selected in preference to coarse gravel, steel balls, or other material because of their extreme hardness and durability to varying temperature changes. The normal pressure drop across the entire dehydration plant is estimated to be 20 psi.

It should be noted that inasmuch as the products are dehydrated before being metered, the holdup stock drained from the towers must be



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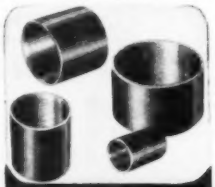

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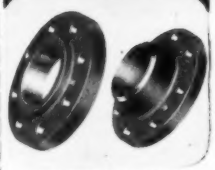

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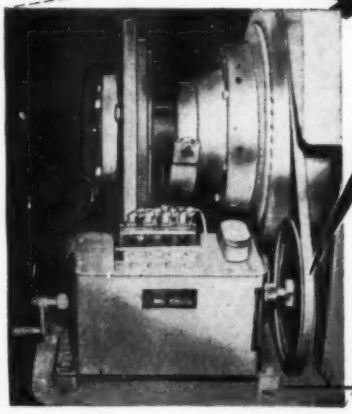

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pumped back into the incoming undehydrated stream. Similarly the sump tank must be evacuated before the tail end of a batch passes the station. This is additional insurance that no undehydrated stock will go into the pipe line and that all stock passes through the station meters.

The water separators will be provided with an automatic water dump valve to dispose of the free water taken out of the incoming stream. The drain chamber and drain valves will be insulated from freezing and equipped with heating elements. The filters in the separators will consist of a bundle of filter packs which can be readily changed or removed as conditions warrant. The filter elements are obtainable in various sizes capable of filtering sediment particles from 5 to 40μ.

A weatherproof instrument panel, not shown in the drawing, will contain: (1) potentiometer for obtaining the desiccant bed temperatures, (2) steam pressure and temperature gages, (3) product temperature and temperature gages, (4) tower pressure and vacuum gages, (5) alarms for indicating excessive pressure drop across towers on stream, (6) alarms for indicating excessive pressure drop across the water separators, (7) other miscellaneous control instruments that are found to be desirable.

The general layout of the plant is designed to permit readily increasing the capacity merely by adding additional towers without a complete redesign of the plant. This future increase in capacity could be obtained on the incremental cost basis as all the lines, equipment, and appurtenances have been sized large enough in the initial installation to provide for this contingency.

It is presently planned to have Standard's Whiting and Wyco's Strouds dehydration plants in operation next year.

Canadian Climate Presents Problems

(Continued from page 177)

across one section of northern Minnesota, where muskeg and peat swamps too large to be detoured must be crossed. Three areas are soft and wet all summer, and will not support the conventional type of equipment used in pipe-line construction. It therefore appears necessary to construct a work road on timber foundation during the winter months along the right-of-way, which will support tracked vehicles used in construction and later what light vehicles might be used for maintenance purposes. It is considered highly impractical and of little, if any, benefit to attempt burying the pipe in these swampy areas, so the plan is to coat and wrap and lay it alongside the work road on top of the moss.

The problem of severe winter temperatures again arose in connection with long sections of exposed line in swampy areas permitting chilling of the oil with consequent increase in viscosity. Nature, however, seldom hands us a lemon without some sugar to go with it, and in this case the material which makes it necessary to expose the pipe to the elements also makes a good overcoat. The wet peat moss can be molded about the pipe and allowed to dry, when it can be wrapped with waterproof paper to form an excellent insulating blanket. It is anticipated that this method of insulation will be used to preserve the excellent "pumpability" of the Canadian crude oil bound for the Great Lakes. This insulation should also prevent excessive expansion of the line when exposed to hot sun.

Present plans anticipate completion of construction of the entire line from Edmonton, Alta., to Superior, Wis., during the year 1950 and the beginning of operation by the end of that year. Lake tankers are to start carrying the Alberta crude to refineries in eastern Canada when navigation opens on the Great Lakes in 1951.

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Testing samples to failure by internal pressure is an important part of a quality-control program designed to obtain pipe which will withstand high pressure safely without wasting steel. Here the author is shown examining the fracture in a ruptured specimen. Observations of the pressure-volume relationship in the region of first yielding are particularly significant. *Benjamin Miller, consulting engineer, 114-55 118th Street, Ozone Park 16, New York, is widely known for his natural gas and pipe-line technology activities and has written extensively for The Oil and Gas Journal. Previous to his consulting work, Miller spent 16 years in the Henry L. Doherty-Cities Service Co. organization. He graduated from Columbia College in 1924*

HOW THICK Should Line Pipe Be?

by Benjamin Miller

FOR years I have been saying and writing that much of the steel put into oil and gas pipe lines has been wasted. Lines are constructed with pipe containing more steel than is needed for the transportation job to be done, and the excess steel is wasted. If this excess steel were run directly from the furnaces and converters into a big hole in the ground, and then covered with earth, the waste would be more apparent, but not more arrant. When a pipe line is being laid it looks as though all the steel is being usefully employed, but if the pipe is thicker than necessary, some of the steel is just being buried in a hole in the ground.

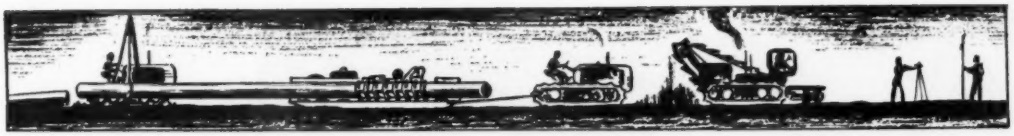
Of course the waste isn't deliberate. It's just that the pipe quality and dimensions are too often specified without any real study of the factors involved. It's easy to play safe by doing again what worked before.

There isn't anything mysterious nor even anything very intricate involved in designing pipe lines which will get maximum oil or gas transportation with minimum steel consumption. There are a good many factors to take into account, and their relative importance will vary from project to project, but the basic ideas are simple, and their application in design quite straightforward.

In designing almost every pipe line it is necessary to consider the kind of fluid to be moved and its quantity, the distance from end to end of the line, and the territory to be traversed; and to determine the pressure conditions, the line diameter, the quality of steel, and the thickness of the pipe. These elements are dependent on each other, and on the pumps or compressors to be used, so that it is not possible to fix any one of them without reference to the others. For our present purpose, however, it is assumed that all the elements have been fixed except the steel quality and the pipe thickness, and the discussion is limited to these two.

Before starting the discussion, it is appropriate to remark that many do practice rational use of steel in pipe lines. Furthermore, I am glad to report that there has been considerable progress during the last 20 years. It is discouraging, however, that the rate of improvement has not been greater, particularly during the war and immediate postwar periods. I had expected the recent steel shortage to be very effective in promoting economical use of steel in pipe lines, but it didn't seem to be.

This is written at a time when steel companies are reducing their production slightly and when further and more drastic cutbacks are being freely predicted. Yet it is generally agreed



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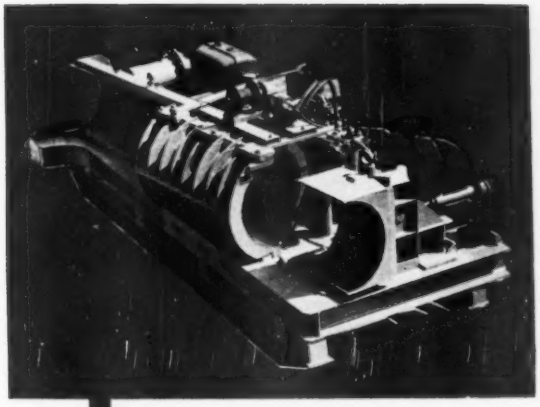

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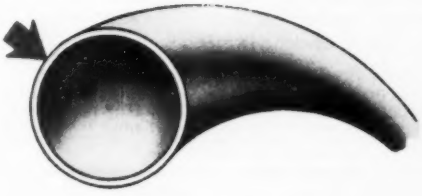

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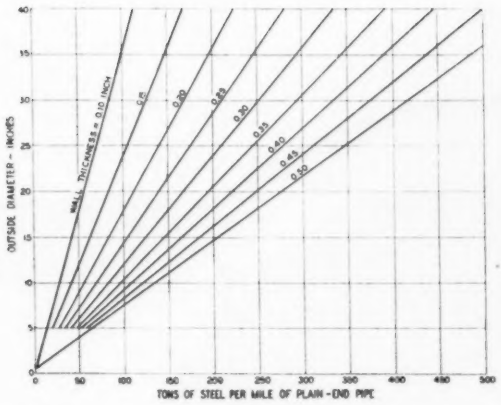

This chart, calculated from the formula, Tons per mile = 28.1956 t (D — t), shows how the steel requirement for pipe lines increases with the outside diameter D and the wall thickness t. A decrease of even .01 in. in wall thickness will save a substantial tonnage of steel in the case of a long, large-diameter line. Wall thickness can be decreased with safety in many cases by combining rational design with quality control

Every length of pipe should be tested hydrostatically to a pressure not less than 125 per cent of the maximum working pressure at which it is expected to be used. Then the pressure should be reduced somewhat, and the pipe carefully examined while the pressure is maintained at the lower value. Here an experienced routine inspector employed by the purchaser on the author's recommendation examines the pipe in the hydrostatic tester

that the reserves of the most desirable steel-making raw materials in the United States have been seriously depleted, with the result that the steel industry in this country will have to base its operations on lower-quality domestic raw materials than it has used before, supplemented to some extent by imported raw materials of higher grade. This suggests that over the long-term future we shall be less able to afford waste of steel than we were in the past.

As there is no indication that the installation of oil and gas pipe lines will soon cease, or even lessen, the incentive to get more oil and gas transportation capacity per ton of steel consumed should increase. If it does, there may be more appreciation than there has been of the economies to be obtained by designing pipe lines in accordance with sound principles.

Stresses Due to Internal Pressure

To move oil or gas through a pipe line economically it is necessary to subject the fluid to high pressure. The fluid transmits the pressure to the internal surface of the pipe, thereby causing stresses in the pipe wall. It is essential that these stresses be not dangerously high, but to make the pipe so thick that all stresses are far below safe values is wasteful.

Two stresses due to internal pressure always exist—a radial compression which at the inner surface is equal to the pressure and decreases to zero at the outer surface; and a tangential tension, usually called the circumferential or hoop tension, whose average value is given by

$$f_h = \frac{P(D-2t)}{2t} \qquad (1)$$

where

f_h = average hoop tension, psi.
P = pressure, psi.
D = outside diameter of pipe, in.
t = pipe wall thickness, in.

Equation 1 is obtained by considering the forces on a semicylindrical portion of the pipe and fluid, as shown in Fig. 1. The forces on the length L of the semicylinder above AB are the upward force exerted by the fluid in the lower semicylinder and the downward force exerted by the lower portion of the pipe. The upward force is the product of the pressure P and the area (D — 2t) L on which it acts, while the downward force is the sum of two pulls, each being the product of the average hoop tension f_h and the area tL across which it acts. Equating P (D — 2t) L to 2 f_htL and solving for f_h yields Equation 1.

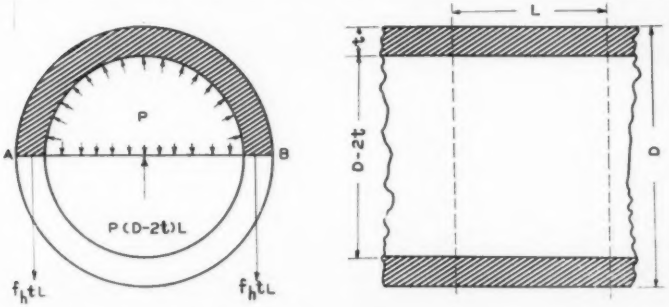

Fig. 1—Forces on a semicylindrical portion of pipe and fluid (see Equation 1)

On the assumptions that the pipe substance is uniform and elastic it can be shown that the hoop tension has a maximum value at the inner surface which exceeds the average value by the fraction tD/(D — t) (D — 2t). This fraction increases as t/D increases, being about 1 per cent when t/D is 0.01 and about 14 per cent when t/D is 0.1. Since the steel in line pipe is fairly uniform and approximately elastic under normal conditions, and since D is nearly always large compared to 10t, the variation of hoop tension across the wall thickness of line pipe is of no practical importance.

Internal pressure may also cause axial or longitudinal stress, which may be compression or tension. The maximum value of longitudinal **compression** which can be caused by internal pressure is equal to the pressure; this occurs when the lengths of pipe are connected by perfect slip joints. Any friction in the slip joints acts to reduce the compressive stress. The maximum value of longitudinal **tension** which can be caused by internal pressure is approximately half of the average hoop tension; this occurs when the pipe lengths are solidly connected, as by welding, and the pipe

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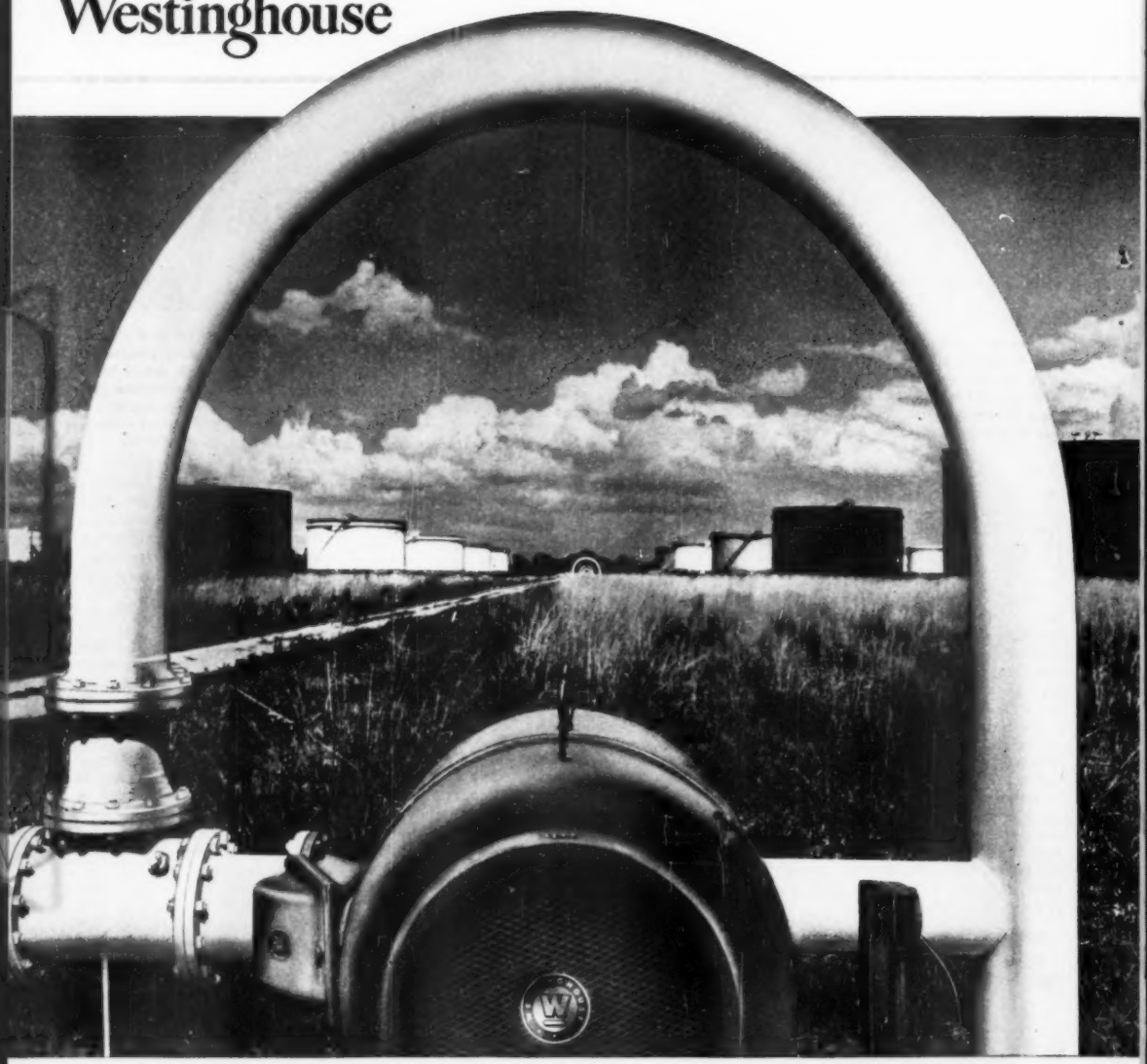

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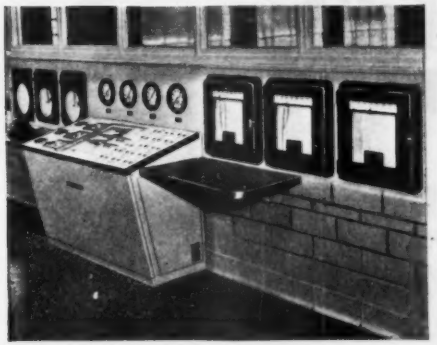
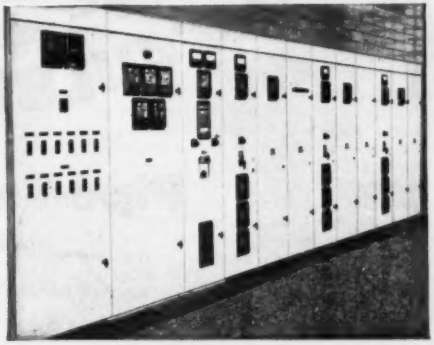


This control desk in a semiautomatic station has flow recorder and controllers for station suction and discharge pressures at left, pushbutton co-ordinated electrical control for pump units and motorized valves in center with pressure gages on panel above, and protective thermocouple recorders at right.



"Unitized" Metal-Clad Switchgear in a semiautomatic pump station, showing (left to right) low-voltage distribution, sequence control for automatic operation of pump units and valves, control of the outdoor main breaker, and reduced-voltage starting equipment for three main-line pump units.

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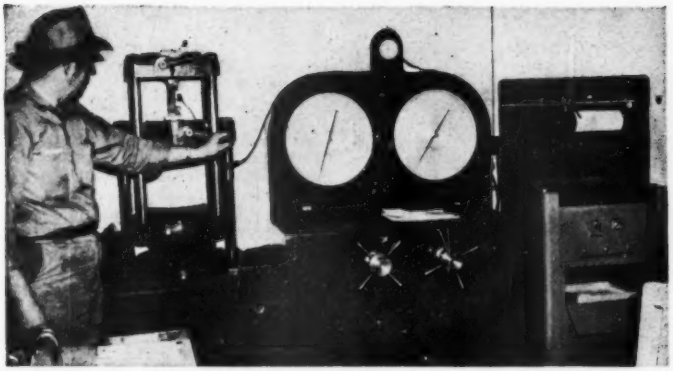

The minimum yield strength and tensile strength requirements of the pipe specification are policed by tensile testing of specimens cut from sample lengths of pipe. Testing machines which automatically produce stress-strain diagrams are available from several makers. Here is shown one such machine installed in a pipe mill on the author's recommendation. Autographic diagrams facilitate production by speeding testing, and eliminate certain possibilities for error

wall alone carries the load due to the action of the pressure on closed ends.

The maximum value of the axial tension is given by

$$f_a = \frac{P\,(D - 2t)\,(D - 2t)}{4t\,(D - t)} \qquad (2)$$

where

f_a = maximum value of axial tension, psi.

Equation 2 is obtained by considering the forces on a portion of pipe and fluid between a closed end and a section such as EF, as shown in Fig. 2. The fluid to the left of EF exerts the pressure P on an area of $(\pi/4)\,(D-2t)^2$, while the portion of pipe to the left of EF exerts a pull which is the product of the tension f_a and the area $(\pi/4)\,D^2 - (\pi/4)\,(D-2t)^2$. Equating the forces and solving for f_a yields Equation 2; comparison of Equations 1 and 2 shows that f_a is $(f_h/2)\,(D-2t)/(D-t)$, or about half of f_h.

A 90° bend is equivalent to a closed end in causing axial tension, while lesser bends cause lesser axial tensions.

To recapitulate: internal pressure causes radial, axial, and circumferential stresses. The circumferential stress is greatest; it is tensile, and its average value is given by Equation 1. The radial stress is compressive, and its maximum value is equal to the pressure. The longitudinal stress may be compressive, in which case its maximum value is equal to the pressure, or tensile, in which case its maximum value is about half the average circumferential stress.

Stresses Due to External Loads

Under normal conditions the stresses in line pipe due to external loads are entirely negligible, and it is difficult to conceive of circumstances which make external loading the controlling element. Usually pipe lines are buried, with cover ranging from a few inches to several feet.

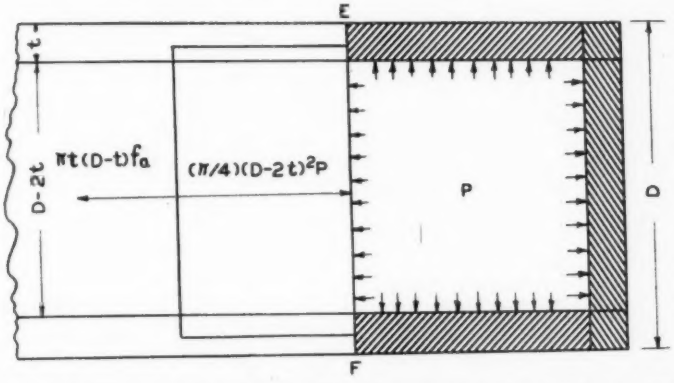

Fig. 2—Forces on a portion of pipe and fluid between a closed end and section EF (See Equation 2)

The stress due to the weight of the cover is insignificant, while the cover protects the pipe against impacts. If the cover is thin, live loads due to vehicles passing over it may be transmitted to the pipe, but even in extreme cases the stresses so caused are small compared to the stresses due to internal pressure. External loading is a serious problem for pipe made of cast iron or ceramic ware or concrete, but the solutions found for such pipe, when applied to steel pipe, indicate that in the case of oil and gas pipe lines made of steel no special treatment is needed because of usual external loads.

Ability to resist external loads in general is increased by internal pressure, and increases rapidly with the t/D ratio. Low-pressure underground water lines made of steel and having t/D ratios much less than those of oil and gas pipe lines are used extensively, and give satisfactory service.

Where a pipe line crosses a river, a canyon, or the like, it is common practice to support the line from an existing bridge or one specially built. If the span is not too great it may not be necessary to use a bridge, as the line may carry its own weight and that of the contained fluid. The stresses in a pipe line acting as a bridge must of course be given special consideration.

There may arise a similar stress state when the earth is washed away from part of a pipe line, leaving that part suspended in midair. When a pipe line is constructed through territory where washouts are probable it is necessary to calculate what stresses will develop if a washout occurs.

Longitudinal tensile stress may also develop because of temperature changes. When steel cools, it tends to contract. If the shortening of a pipe line on cooling is prevented, there develops a longitudinal tensile stress equal to that which would be required to stretch the pipe line an equivalent length, that is, the difference between the hot length and what the cold length would be in the absence of restraint.

If the shortening is completely prevented, the stress developed is 180 psi. for each degree Fahrenheit. Under extreme conditions there might be a difference of 100° F. between the temperature at the time of installation and a subsequent minimum temperature, which would mean a potential stress of 18,000 psi. No such stress appears, however, because the contraction is not completely prevented. Every line as installed has wiggles and waves, even when no special effort is made to allow for contraction, so that when the temperature drops the line does shorten by becoming more nearly straight, and the tensile stress developed is but a small fraction of the potential.

Pipe lines, like other structures, may be damaged or destroyed by earthquakes, lightning, explosions, or

other catastrophes, but the stresses due to such external agencies are not calculable.

Paramount Importance of Hoop Tension

It follows that the maximum stress in the steel of a pipe line is the hoop tension due to the internal pressure, except in the special case where the line is acting as a bridge, so that if the hoop tension is not excessive, the other stresses will not be excessive either. Now it is true that when steel is subjected to stresses in two or three mutually perpendicular directions, the highest safe value of the maximum stress is dependent to some extent on the values of the lesser stresses.

If the maximum stress is tensile, then compressive stress at right angles to it acts to weaken the steel, while tensile stress at right angles to the maximum stress acts to strengthen the steel. Thus the radial stress, and the compressive longitudinal stress which exists when the lengths of pipe are connected with slip joints, both act to lower the highest safe value of the hoop tension. However, this weakening effect depends upon the relative magnitudes of the stresses, and since the compressive stresses never exceed the pressure, while the hoop tension is many times as great as the pressure, the weakening effect is negligible. The strengthening effect of longitudinal tension would be important if there always were longitudinal tension; since its presence depends upon closed ends or bends, and its magnitude may be reduced by soil friction, no credit can be taken for longitudinal tension.

It may be asked why it is necessary to discuss other stresses and other loads when the hoop tension due to internal pressure is alone controlling. The answer is that in the absence of such discussion it might be supposed that allowance should be made for other stresses and loads of unknown magnitude in the form of additional pipe wall thickness, in some arbitrary amount, whereas no such allowance is justified.

What Is the Highest Safe Hoop Tension?

The question "How thick should line pipe be?" can now be answered in this way: of such thickness, considering the diameter and maximum operating pressure, that f_s as calculated by Equation 1 will not exceed, **nor be substantially less than,** the highest safe hoop tension.

Formerly the highest safe static stress in all-steel structures was taken as the quotient obtained by dividing the ultimate strength by a "factor of safety" of 3, 4, or 5. The factor of safety was intended to allow for deterioration, poor workmanship, accidental and uncalculated loads, and other contingencies, and was frequently referred to, with some justice, as a "factor of ignorance."

It is now becoming appreciated that when ductile metals such as the types of steel used in line pipe are subjected at ordinary temperature to slowly increasing tension, substantial plastic deformation occurs before rupture. It is therefore sound to use as the highest safe hoop tension the stress corresponding to a small but well-marked plastic deformation, which may be in the range 0.1 to 0.3 per cent. That is to say, if the hoop tension does not exceed the stress which would cause a small but well-marked plastic deformation of the order of 0.1 to 0.3 per cent, the wall thickness is adequate. In practice it is still necessary to allow for gaps in our knowledge, because it is not practical to control the thickness of the pipe nor the properties of the steel within very small limits. How the necessary allowances should be made will be discussed after we have considered the important topic of yield strength.

Meaning and Measurement of Yield Strength

Stress at which a material exhibits a specified limiting permanent set is called the yield strength; this is the definition adopted by the American Society for Testing Materials. To determine the yield strength strictly in accordance with this definition is difficult, and requires equipment and technique not generally available. There are two approximations to the yield strength which are much more easily determined, the offset yield strength and the total strain yield strength, and either of these may be accepted as the highest safe hoop tension.

Yield strength in general is determined by making a tension test in accordance with A.S.T.M. Standard E 8. When the offset yield strength is desired, a stress-strain diagram is drawn, either by the testing machine itself (autographic diagram), or from numerical data obtained by observation of load and extension measuring instruments during the test. Two stress-strain diagrams are shown in Fig. 3.

Stress-strain diagram OABCX shows the behavior typical of some steels — the stress and strain increase together until a critical stress is reached, and then there occurs a marked increase in strain without increase in stress. This critical stress is called the yield point.

Many steels do not have a yield point, but instead behave as shown by diagram OADEY, the stress increasing with the strain continuously, but at a decreasing rate.

It has been found that if in a tension test the load is released, the stress-strain diagram for decreasing load is approximately parallel to the straight-line portion of the increasing-load diagram. Thus if at point B of Fig. 3 the load is released, the decreasing-load stress-strain diagram will follow very closely the line BP, which is parallel to OM, the straight-line portion (prolonged) of the increasing-load stress-strain diagram. The plastic deformation, which is the permanent strain or set after the release of load at B, is thus approximately equal to the offset OP, or 0.1 per cent in the case shown in Fig. 3. In the same way, if in the test of the steel without a yield point, the load is released at point D of Fig. 3, the permanent set will again be approximately equal to the offset OP.

Thus to determine the offset yield strength, the specified offset is laid off on the strain axis (as OP in Fig. 3) and a line drawn through the point P parallel to the straight-line portion of the stress-strain diagram (as PN in Fig. 3). The intersection of the line so drawn through P and the stress-strain diagram (as B or D in Fig. 3) is the point whose stress coordinate is the offset yield strength.

It will be noted that when a material has a yield point, its offset yield strength will be the same no matter what value of offset is specified, within wide limits. A material which does not have a yield point can have any number of offset yield strengths, depending on the offset specified.

The selection of the offset to be used is somewhat arbitrary. I have found that an offset of 0.1 per cent is large enough to be easily used.

If the general shape of the stress-strain diagram for a particular type of steel is well known because many diagrams have been plotted, the total strain corresponding to the yield strength at a specified offset will be

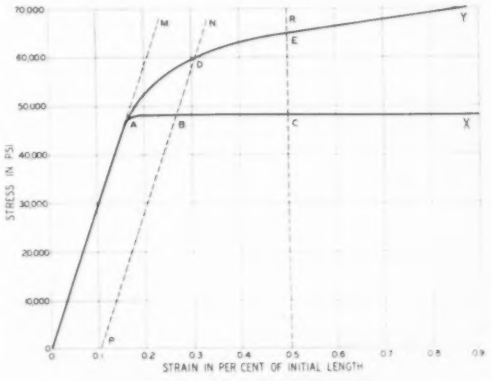

Fig. 3—Two stress-strain diagrams

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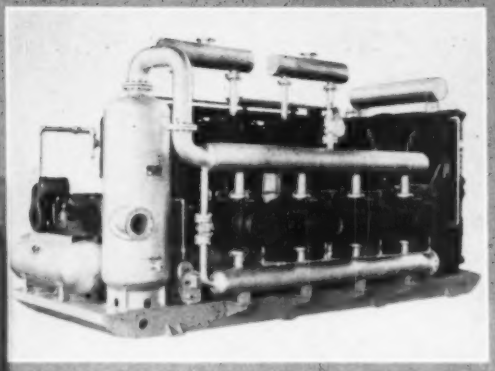

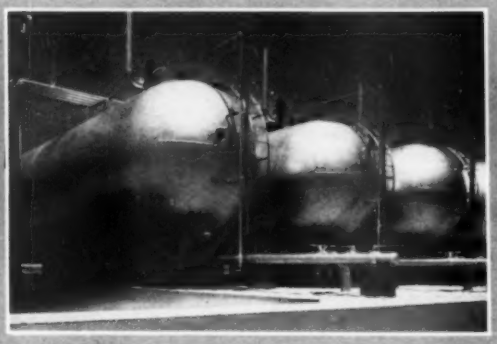

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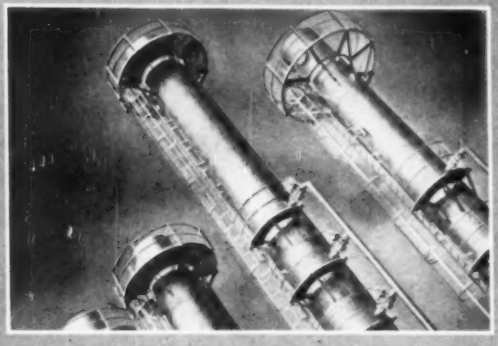

CAST STEEL FLANGED FITTINGS

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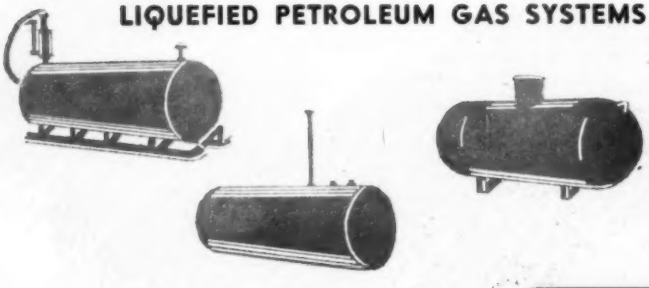

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known within narrow limits. In such a case the total strain yield strength may be substituted for the offset yield strength, the total strain yield strength being defined as the stress when a specified total strain has been reached. For example, a steel whose stress-strain diagram is like OADEY of Fig. 3 exhibits a total strain of about 0.5 per cent for an offset yield strength of 0.3 per cent.

The advantage of substituting the total strain yield strength for the offset yield strength is that the number of stress-strain diagrams to be plotted is reduced, it being necessary only to plot one occasionally to make sure that the general shape has not changed.

It is also possible to use the total strain yield strength as the primary criterion, and dispense with the offset yield strength entirely. The total strain yield strength to be used as a primary criterion must also be selected arbitrarily. The American Petroleum Institute line-pipe standards use 0.5 per cent, which is convenient.

Allowance for Uncertainties

The ideal situation would be for the steel in the pipe to be stressed in use so that there was a small plastic deformation. If the pressure, the pipe-wall thickness, and the yield strength of the steel were such that the circumference of the pipe increased by 0.5 per cent over the original value, the steel would not be wastefully understressed, nor dangerously overstressed.

This ideal cannot be reached, nor even approached in practice because of uncertainties as to the actual pressure, the actual pipe wall thickness, and the actual yield strength of the steel. We can of course measure all of these, with fair precision, but **for design purposes measurements are too late: design must be based on predictions.** It is known that the pressure will vary from time to time and from place to place along the line, that the thickness of the pipe will vary, and that the yield strength of the steel will vary. It is necessary to predict what the maximum pressure, minimum yield strength, and minimum wall thickness will be.

Usually a minimum yield strength and a minimum wall thickness (or a nominal wall thickness and an under-thickness tolerance, which amount to the same thing) are stipulated, and any length of pipe having a lesser wall thickness or containing steel of lower yield strength may be rejected. Since it takes too long and costs too much to measure the actual wall thickness and yield strength of every length of pipe, measurements on samples must be used in an effort to determine that the pipe complies with the stipulations. As there is bound to be some variation in wall thickness and some variation in yield strength, it is not possible to be certain from the measurements on samples that no length will have a wall thickness less than the stipulated minimum, or that no length will contain steel of yield strength lower than the stipulated minimum, but by suitable quality-control methods the probability that substandard pipe will be accepted can be made quite small. Allowance for that small probability must still be made.

Variations in pressure may be allowed for by establishing for the pipe a maximum allowable working pressure, and then providing a test pressure substantially higher. If every length of pipe is tested either at the mill or in the line to a pressure substantially higher than the established maximum allowable working pressure, in effect it is predicted that the pipe will never be subjected in service to a pressure higher than that which it successfully withstood under test conditions.

To recapitulate: a maximum allowable working pressure is established, and it is arranged that every length of pipe in the line is tested at a pressure substantially higher, which test pressure is the predicted maximum pressure to which the pipe will be subjected; a minimum pipe wall thickness is stipulated, and it is thus predicted that pipe with thinner wall will not get into the line; and a minimum yield strength is stipulated, and it is thus predicted that pipe containing steel of lesser yield strength

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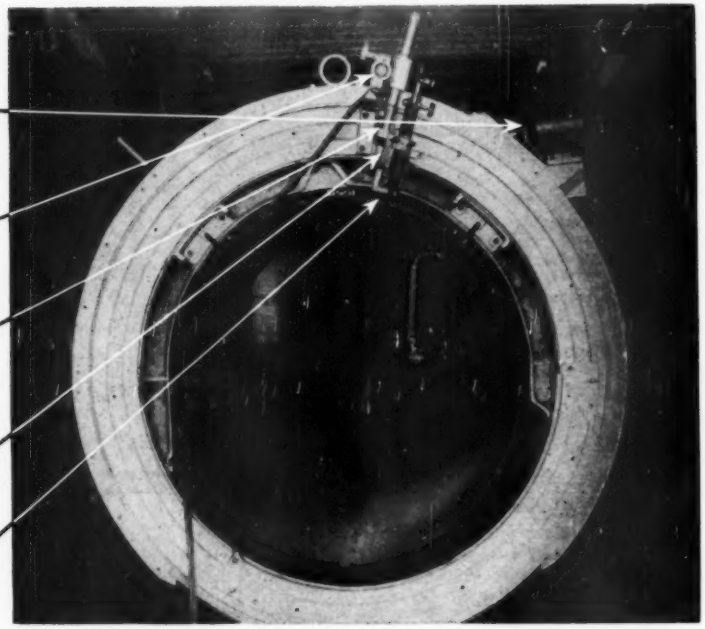

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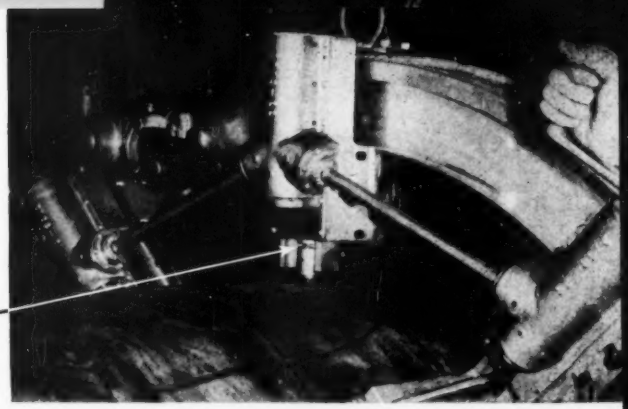

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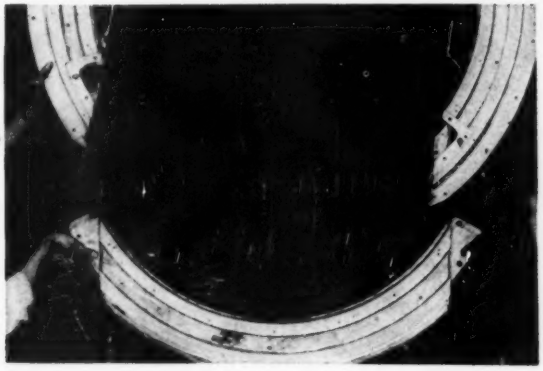

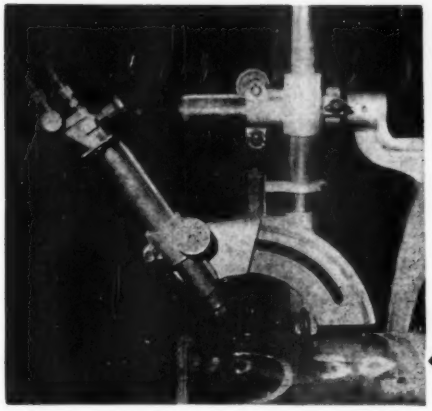

Calibrated arc assembly showing torch in position for cutting nipples. The torch assembly arc permits a maximum bevel angle of 40 degrees in either direction.

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will not get into the line. Then by Equation 1 it is calculated that the predicted maximum pressure applied to pipe of the predicted minimum wall thickness will not cause f_s to exceed the predicted minimum yield strength. Actually there is a small probability that one or more of the predictions will be wrong; to allow for this probability, the pipe-wall thickness is so stipulated that the so-calculated value of f_s is substantially less than the predicted minimum yield strength.

There are many ways to make the necessary allowances, even without analyzing the problem. One of the simplest is to follow the rules of the American Standard Code for Pressure Piping. The code is intended to prescribe only minimum safety standards, but the allowances made are adequate for the great majority of oil and gas pipe lines. Furthermore, the code allows many alternatives, all of which may be safe, but it is still necessary to use judgment to combine safety with economy.

While it is not at all difficult to follow the code, it does require some study to understand how the code rules correlate with the principles set forth above.

Trunk Oil Pipe Lines Under the Code for Pressure Piping

The American Standard Code for Pressure Piping, approved by the American Standards Association and designated B31.1, covers piping systems of many kinds. Included in Section 3 of the code are Trunk Pipe Lines Outside of Refinery Limits—Cold Oil, High Pressure (Class 4), and Section 2 includes cross-country gas-transportation systems (Division 2). While the code should be referred to for exact definitions of coverage, these are the piping systems which are commonly referred to as oil and gas pipe lines, and line pipe generally means pipe used in such systems, which is what it is intended to mean herein.

Minimum wall thickness of pipe in oil lines is determined by Equation 3 as follows:

$$t_m = \frac{{}^{\circ}PD}{2S + 0.8\,{}^{\circ}P} + C \qquad (3)$$

where

t_m = minimum pipe wall thickness allowable on inspection at the time of installation, in.
$^{\circ}P$ = maximum internal service pressure, psi.
D = outside diameter of pipe, in.
S = allowable stress in material due to internal pressure, psi.
C = allowance for threading, mechanical strength, and or corrosion, in.

The value of C is 0.05 for plain-end steel pipe larger than ¾ in. o.d., but zero for plain-end nonferrous pipe, such as aluminum pipe; and S for

trunk oil pipe lines is 85 per cent of the product of the specified minimum yield strength and the joint efficiency.

The code does not require that pipe for use in oil lines be tested before installation, but it does require that high-pressure trunk pipe lines be capable of withstanding a hydrostatic test pressure of either 1½ times the service pressure, or a pressure which will stress the pipe (as calculated by Equation 3 above) to 95 per cent of the minimum yield strength required by the applicable pipe specification, whichever is lower. Thus the test pressure is at least 95/85 times the maximum allowable working pressure established for the line.

When the internal service pressure is the maximum permitted by the code, P is equal to *P, and eliminating the pressure between Equations 1 and 3

$$f_h = S \frac{D - 2t}{D - 0.8\,(t_m - C)} \cdot \frac{t_m - C}{t} \qquad (4)$$

Equation 4 shows that f_h is always less than S provided $t_m - C$ is not greater than t, if the pressure does not exceed the maximum permitted by the code under service conditions. If $t_m - C$ is equal to t, f_h under maximum allowable service pressure will be less than 85 per cent of the minimum specified yield strength, leaving a margin of at least 15 per cent of the minimum specified yield strength to allow for the possibility that the actual service pressure will exceed the predicted maximum value, the actual wall thickness will be less than the stipulated minimum, and/or the actual yield strength will be less than the stipulated minimum. Under the test pressure the margin is at least 5 per cent.

Cross-Country Gas Pipe Lines Under the Code for Pressure Piping

The code does not require that pipe be inspected for wall thickness prior to or at the time of installation in cross-country gas lines (Division 2 gas piping systems); only the nominal or specified wall thickness of such pipe is mentioned. This means that the allowance for uncertainties includes allowance for underthickness tolerance. The margin to allow for the possibility that the actual service pressure will exceed the predicted maximum value, the actual wall thickness will be less than the nominal or specified value, and/or the actual yield strength will be less than the predicted minimum is at least 28 per cent of the stipulated minimum yield strength, for steel or wrought-iron pipe.

The margin of at least 28 per cent of the predicted minimum yield strength may be obtained in one of two ways. The code requires that pipe (other than cast-iron pipe) manufactured **hereafter for use in gas pipe lines** safely withstand a hydrostatic test pressure stipulated in the specification under which the pipe is manufactured. Division 2 piping systems may be constructed with pipe which **has not** been so tested; such systems are limited as to operating pressure in accordance with Equation 5 as follows:

$$^*P = \frac{1.44\,Kt_s}{D} \qquad (5)$$

where

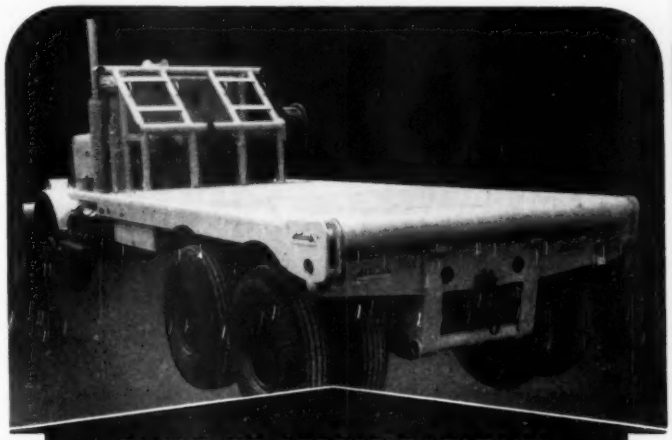
*P = maximum allowable working pressure, psi.
K = effective yield strength, psi.
t_s = nominal or specified pipe wall thickness, in.
D = outside diameter of pipe, in.

When the pressure is the maximum allowable, P is equal to *P, and eliminating the pressure between Equations 1 and 5

$$f_h = 0.72K \frac{D - 2t}{D} \cdot \frac{t_s}{t} \qquad (6)$$

Equation 6 shows that when the working pressure does not exceed the maximum allowable, f_h is less than 0.72K as long as the actual thickness is not less than the specified or nominal thickness, so that the margin is at least 28 per cent of the predicted minimum yield strength.

Division 2 piping systems constructed with pipe which **has** been so tested are allowed a maximum working pressure equal to 80 per cent of the



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test pressure. The test pressure in turn is limited by Equation 7 as follows:

$$P_m = \frac{1.80K\ t_s}{D} \qquad (7)$$

where P_m = maximum test pressure in psi., and the other symbols are as previously defined.

When the pressure is the maximum test pressure allowable, P is equal to P_m, and eliminating the pressure between Equations 1 and 7

$$f_s = 0.90K \frac{D - 2t}{D} \cdot \frac{t_s}{t} \qquad (8)$$

Equation 8 shows that the margin in the hydrostatic test to allow for the possibility that the actual thickness is less than the nominal or specified value and/or the possibility that the actual yield strength is less than the predicted minimum yield strength is not less than 10 per cent. Furthermore, since the maximum allowable working pressure is 80 per cent of the test pressure, the value of f_s is less than 0.72 K when the working pressure is the maximum allowable and the thickness is the specified value, so that the margin for uncertainties is again 28 per cent of the predicted minimum yield strength.

Comments on "Allowance for Mechanical Strength and/or Corrosion"

In my opinion the "allowance for mechanical strength and/or corrosion" (the term C in Equations 3 and 4 above) should be zero for plain-end steel pipe in trunk oil pipe lines just as it is for nonferrous pipe. The only nonferrous pipe so far used for trunk oil pipe lines is aluminum pipe, and certainly no one would seriously contend that steel pipe has less mechanical strength than aluminum pipe, or is more likely to be rendered unsafe by soil corrosion. There are some oils which are corrosive to steel and not to aluminum, but this circumstance should not be cause to derate steel in the large number of cases where lines carry oils which are not corrosive to steel.

Putting comparison with aluminum aside, the requirement of an arbitrary additive thickness as an "allowance for mechanical strength and or corrosion" is unwarranted for trunk oil pipe lines because it has no sound basis. A **minimum** wall thickness to provide mechanical strength against external loading can be justified, but the ability to resist external loading is not decreased by internal pressure, so that mechanical strength does not require **additional** thickness. It is true that pipe can be weakened by corrosion, but there are methods for protecting pipe against corrosion which in many cases are preferable to adding steel.

The arbitrary addition of 0.05 in. to the wall thickness may not seem important at first glance, but on a 12¾-in. o.d. line 600 miles long it amounts to an additional 10,000 tons of steel.

Recommendations for Action

Where the Code for Pressure Piping has been adopted by state legislatures and has the force of law it is of course necessary to comply with it. Under other circumstances it is recommended that the minimum margin required by the code—23 per cent of the predicted minimum yield strength when using the nominal wall thickness, or 15 per cent of the predicted minimum yield strength when using the stipulated minimum wall thickness (nominal wall thickness less under-thickness tolerance)—be adopted, **provided** (1) that every length of pipe is subjected to and safely withstands a hydrostatic test before installation at a pressure not less than 125 per cent of the maximum working pressure established for the line; and (2) that the pipe production is subject to adequate quality control from molten metal to shipment.

The standard pipe specifications allow an underthickness tolerance of 12½ per cent. This is unnecessarily high. The standard underthickness tolerance for plates ordered to thickness is 0.01 in.; specifications for pipe made from plate should stipulate the same tolerance, and competition with pipe made from plate should reduce the tolerance demanded for seamless pipe.

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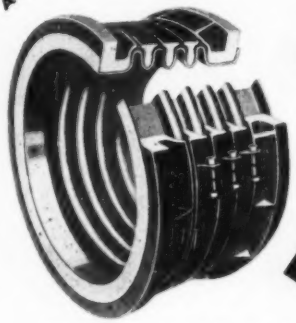

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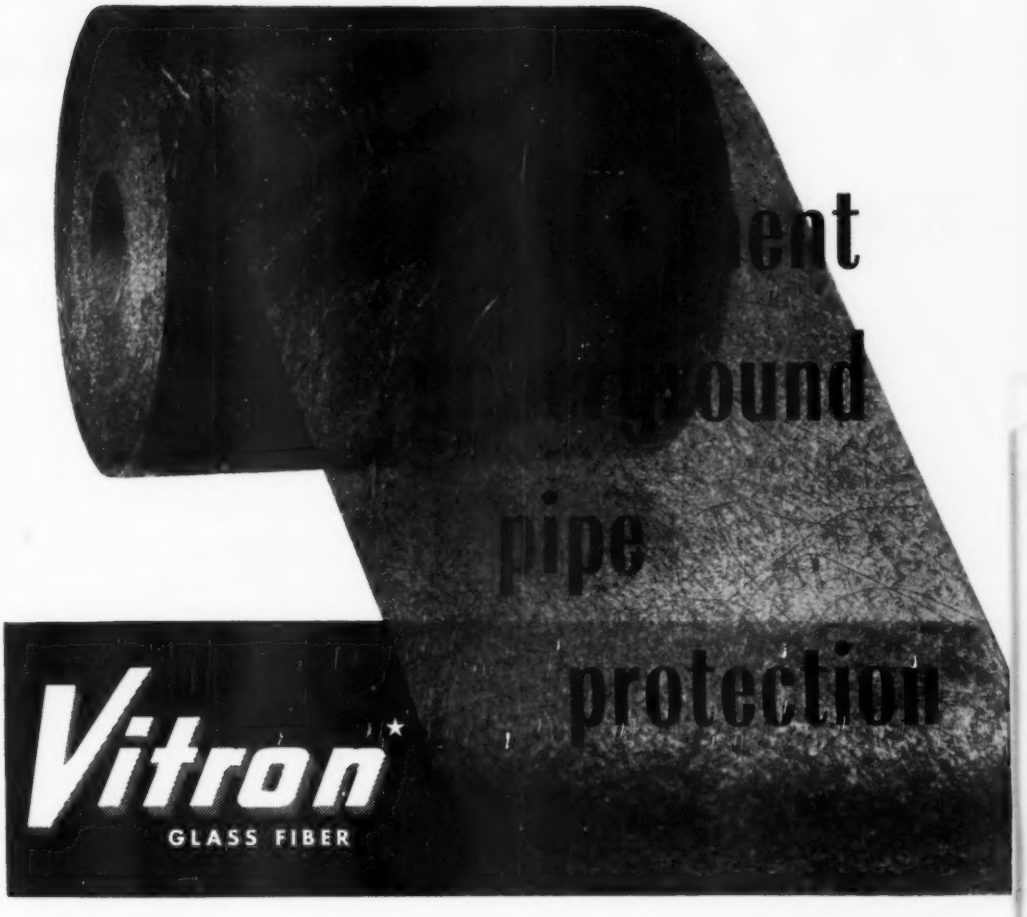

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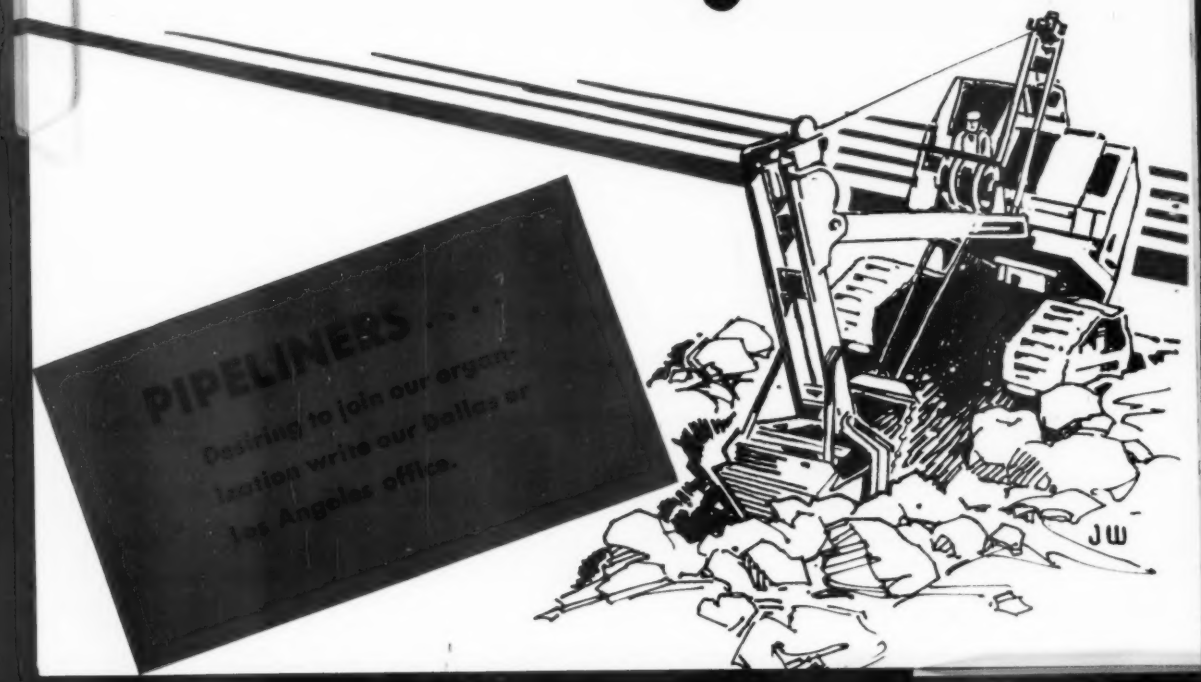

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gle cause of waste is the habit of specifying Grade B line pipe. This grade, with its 35,000-psi. minimum yield strength, was as good as one could hope to get 20 years ago, but now there are several suppliers who regularly furnish line pipe with 52,000 psi. minimum yield, and there is no reason to suppose that substantially stronger line pipe cannot be obtained. Casing having minimum yield strengths of 55,000 and 80,000 psi. was made available when the production branch of the industry demanded stronger material, so why shouldn't line pipe of comparable strength be produced?

In my opinion it should not be too difficult to obtain line pipe having 60,000-psi. specified minimum yield strength right now, and if the free-enterprise system is allowed to function in pipe production, line pipe will soon be obtainable on specifications calling for 70,000 psi. minimum yield strength. It should be emphasized that new metallurgy will not be required to produce such pipe, nor will mill practice not previously applied in line-pipe production. With new metallurgy and mill practice much higher yield strength may be possible, but the present recommendations are limited to rational use of technology which has already been abundantly demonstrated.

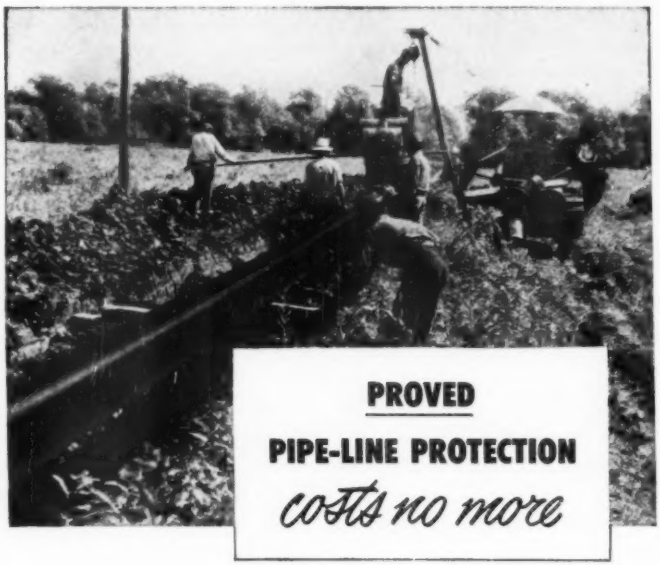
I realize that prediction of 70,000-psi. minimum yield strength line pipe may seem starry-eyed optimism to some. They would have felt the same way in 1936 about 45,000-psi. minimum yield strength. In that year, with pipe producers anxious for business, only three would quote on line pipe under a specification requiring 45,000-psi. minimum yield, and the two from whom it was ordered had a little trouble in meeting the stipulations. Application of what was learned in filling that 1936 order and the normal progress of the art resulted in steady increase in the specified minimum yield strength acceptable to pipe producers, so that in 1943 line pipe could be purchased under a specification requiring 56,000-psi. minimum yield strength, and the production of this pipe was routine

Some Final Words of Caution

Pipe-wall thickness depends upon the diameter and the pressure conditions, and the determination of the optimum values of these includes consideration of fluid mechanics. It is assumed that fluid mechanics and pipe strength will be properly combined.

There are several ways to make line pipe, and they differ as to the range of diameters for which they can be used, the minimum thickness in each diameter, and the quality of the product. In some cases minimum steel use can be accomplished by using pipe of relatively low quality produced by a process which is adapted to making large-diameter, thin-wall pipe.

Line pipe is used in oil refineries, tank farms, terminals, natural-gasoline plants, gas-processing plants, etc., and what has been said above is not intended to apply to line pipe so used, but only to pipe used in cross-country pipe-line systems, and not to all the pipe used in these systems. Pipe used in oil-pumping stations and gas-compressing stations may be subjected to vibration and thermal shock, and its thickness requires special consideration. Submerged river crossings, and lines through swamps or under lakes or the ocean, have their own peculiar problems. There remains, however, an enormous mileage of just plain pipe line, which presents both challenge and opportunity to save dollars and steel.



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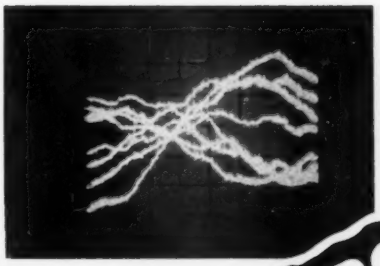

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Similar tests can be performed in your own system to demonstrate the effectiveness of a Greer Accumulator.

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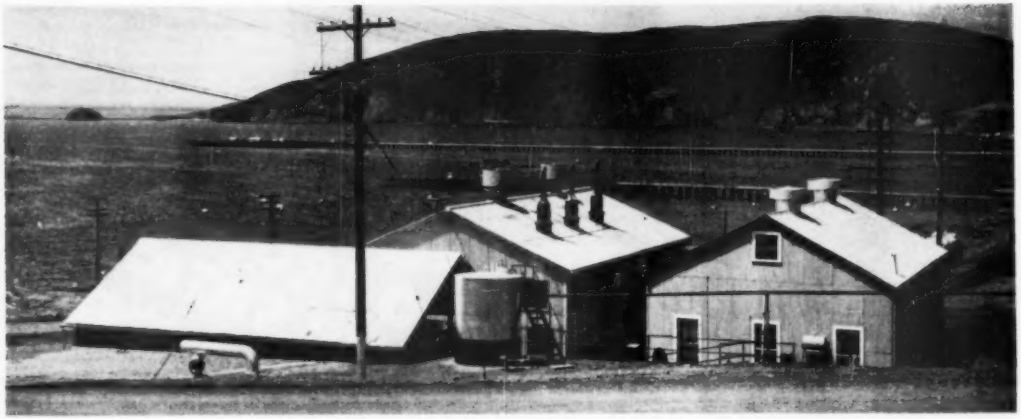


View of Avila Harbor. The Union Oil loading dock is the long dock in background. The building at right houses a small control laboratory, storage, change area, and offices. The engine pump house is at the left. The low-roofed building houses four steam-oil heaters

One of California's Oldest Pumping Stations Now One of Its Most Modern

by Robert Harwick
District Editor

ONE of the oldest pumping stations in California, Union Oil Co.'s Avila terminal, now also ranks as the newest station in the state. The original station was built in 1910 and terminal installations there have been in operation since that time.

The plant has now been enlarged and completely modernized at a cost of 1¼ million dollars. Present rated capacity is 20,000 bbl. per hour.

The Avila terminal is on the California coast just north of Pismo Beach and about 10 miles west of San Luis Obispo. It is the receiving and shipping point for Union Oil crude-oil production. Two lines come to the terminal from the San Joaquin Valley, Midway-Sunset area, and two lines come from the coastal fields, Santa Maria area.

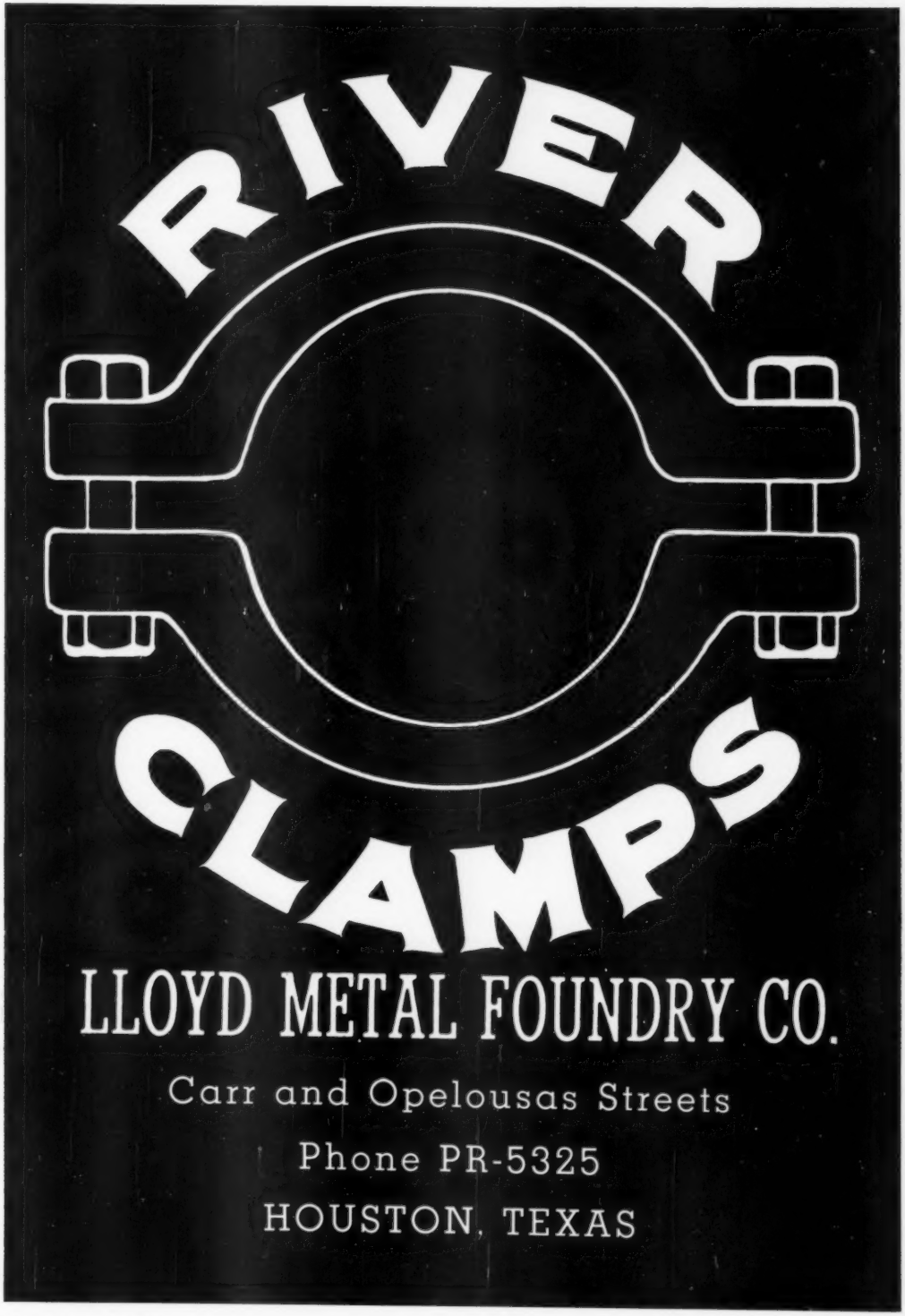
The crude arrives at the terminal already dehydrated and stabilized. No further treatment is required before shipment.

The crude is shipped from the terminal by tanker. Tankers are loaded at a 2,600-ft. dock about a mile from the station. They take the crude to Union Oil refineries at Oleum, near San Francisco, or to Wilmington near Los Angeles.

The station also serves as bulk plant for the San Luis Obispo district. Refined products are brought in by tanker and distributed through the local marketing area by truck. About 22,000 bbl. of gasoline are handled per month.

The expansion program, improvement of existing facilities, and re-

Left: The Avila terminal looking inland. Refined products loading rack is at left. The engine jacket-water coolers are shown in the foreground. The individual coolers control the temperature of jacket water through automatically operated shutters located on the far side of the radiators. At the left end of the pump house is the discharge manifold leading to the dock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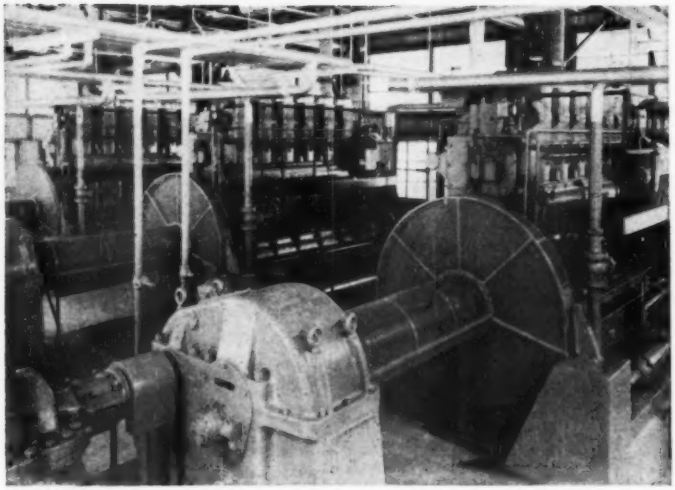

The engine-pump house interior. The pumps are powered by dual-fuel, 460-hp. Enterprise engines through Pacific Western stepup gear boxes. Stepup is 450 to 1,780 r.p.m.

placement of outmoded equipment was accomplished over a period of 6 months. The work was planned and carried out in such a way that there was no interruption of normal station operation during construction.

The modernization program was under the supervision of Fritz Korge, manufacturing department, Union Oil. J. B. Gill Co. handled the engineering and the station construction work. Webb Construction Co. did most of the field work. The job was completed in June and the new installations are now in full operation.

First comparative figures show that the program has resulted in a reduction of tanker loading time by one-third. Further, the faster loading time has been achieved with an overall fuel saving of 80 to 90 per cent over former fuel requirements.

Before modernization, two centrifugal pumps, powered by steam turbines, moved the oil from tanks to tanker. The steam was generated in four, 300-hp., gas-oil-fired boilers.

This power setup is now replaced with three 460-hp. Enterprise dual-fuel engines. Two engines serve the operating needs of the station. The third installation is standby.

The centrifugal pumps, single-stage Ingersoll-Rand SHV's, used with the former turbine installation, have been worked over but are again in use with the new power system.

Part of the alterations made on the pumps was adapting them for the new power plants, which necessitated speed-increasing gears between the engines and the pumps. Pacific Western high-speed-type stepup gears were selected to give a pump speed of 1,780 r.p.m.

The engines installed in this plant are unique in California pipe-line operations. This is the first use on the West Coast of dual-fuel engines for the variable-load, variable-speed service met in pumping-station work. In the Avila terminal speeds vary from 325 to 450 r.p.m. and from one-fourth to full load.

The engines are six-cylinder, 12-in. bore, 15-in. stroke, four-cycle, 460-b.hp, 450-r.p.m., nonsupercharged. The pilot diesel fuel-injection system is designed to provide for full engine output as a diesel as well as a gas-diesel without change in the injection system. Pilot fuel consumption ranges between 5 and 10 per cent.

Gas fuel is admitted at between 1½ and 3 psi. Gas admission is directly into the air passage but is not timed to the admission cycle. The gas admission is balanced so that each cylinder output is equal to all other cylinders.

Balancing of the individual cylinders is accomplished by adjusting a needle valve until the exhaust temperatures of individual cylinders balance within close limits.

The initial selection of the proportion of the gas fuel to the pilot fuel is manual. The governor controls the amount of gas fuel that is added to the selected amount of diesel fuel. The amount added is sufficient to sustain the speed and the load requirements.

Controls are of such a nature that it is impossible to adjust them so that the combined percentage of pilot fuel and gas fuel will be in excess of the amount required for full-load operation.

Safety controls are built into the engine to provide for automatic shutoff in the event of excessive jacket-water temperature, low lubricating-oil pressure, or overspeed of the engine. The sequence of shutdown is to cut off the gas supply before the pilot fuel is cut off. This procedure eliminates the possibility of an explosion due to accumulated gas in the exhaust stack.

Separate jacket-water coolers are provided for the engines. These are of the radiator type with automatic air shutters, thermostatically controlled.

The Pacific Western speed increasers in this plant have all lubricating-oil and heat-exchanger piping enclosed within the case to reduce the danger of damage or accidental breakage. Temperature and pressure indicators are grouped on a panel located on the side of the lower gear case. The oil pump is driven off the low-speed shaft and mounted on the outside for easy accessibility.

To take care of the faster movement of oil, the station piping system was revamped. Manifolding and bypass systems that had been added to, through the years, were simplified. A former 12-in. sunction line from tanks to pumps is now replaced with a 20-in. line. Two 16-in. suction lines were held as before. Manifolding was revised to provide separate lines for light and heavy oil.

It was not necessary to increase the size of the discharge lines. The two 12-in. and one 16-in. lines have sufficient capacity for the new pumping equipment.

Cathodic protection was also added to all underground lines.

New tankage was built raising the terminal storage capacity to 1,000,000 bbl. This required addition of two 113,000-bbl. and one 135,000-bbl. tank.

Also, under the new program the foamite system in the tank farm was changed from wet to dry.

For rapid gaging and checking purposes, Shand & Jurs automatic, remote gages are installed in the field tanks. This installation permits gaging from the station control board. Accuracy is within ⅛ in.

Discharge pressures naturally vary with the gravity of the oil being pumped. Heavy oils average 160 psi at this point; light oils 120 psi.

At the dock the discharge pressure is held to 110 psi. Controls at the dock automatically shut down the pump engines if discharge pressure at the dock reaches 125 psi. In addition, there is a manually operated shutoff switch at the dock for emergency use.

Water ballast carried by incoming tankers must be handled with extreme care at Avila. This part of the coast is a resort area with fine bathing beaches. Ballast is pumped from ship to special tanks near the pumping station. After settling, the water is run through skim ponds. The collected oil is pumped into heavy-crude storage.

Operating Data for New Terminal in Servicing The SS Lompoc (June 15-16, 1949)

Drop anchor 5:20 p.m.
Discharge 2,300 bbl. ballast.
Discharge 3,000 bbl. gasoline.
Loaded 116,000 bbl. 31°-gr. crude, 80° F
On hose 6 hours, 50 minutes.
Average 17,058 bbl. per hour.
Best 4-hour average 20,030 bbl. per hour
Up anchor 1:40 a.m.

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The No. 855 thermostat is used for line voltage applications where it is desired to handle the full motor load directly without the use of a relay. Available with "on-off" manual switch for unit heater applications. These thermostats are used for both heating and refrigeration applications.

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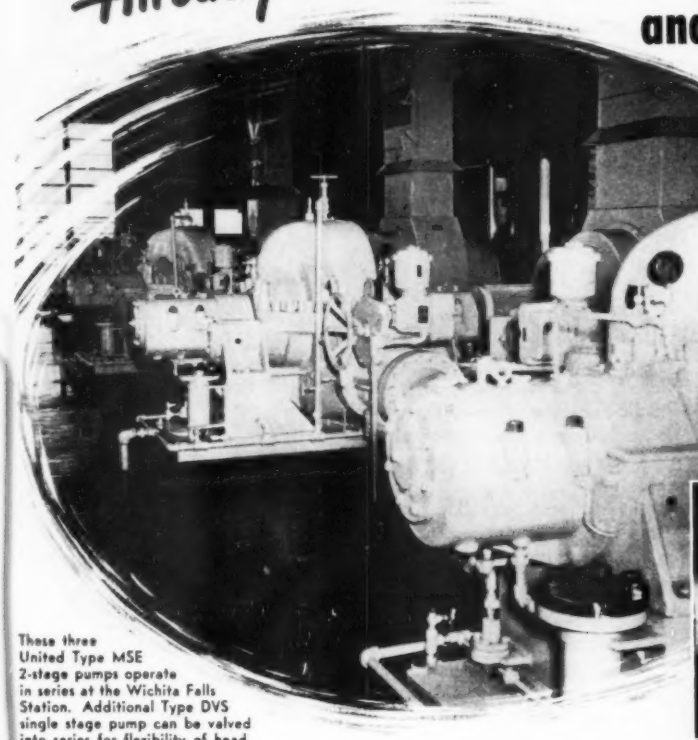
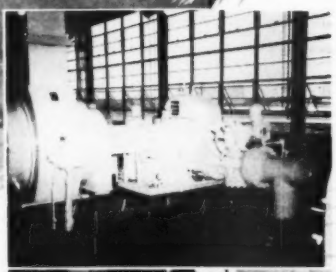
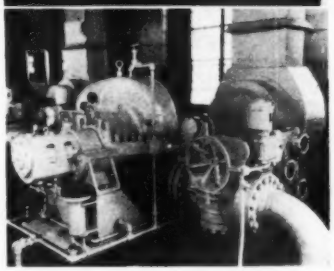
Already at Work on the Basin and Ozark Systems



These three United Type MSE 2-stage pumps operate in series at the Wichita Falls Station. Additional Type DVS single stage pump can be valved into series for flexibility of head.





Upper Right: Typical United installation shows one of the United pumps on the Basin System.

Lower Right: Rated for peak efficiency at 1750 rpm, these United pumps are designed for dependable service with minimum maintenance.

66 United Centrifugal Pumps will help push oil through the great new 20, 22 and 24-inch lines from Jal, New Mexico, to Patoka, Illinois — over one thousand miles. Operated by The Texas Pipe Line Company and Shell Pipe Line Corporation, the systems will comprise in size, length and capacity the largest crude oil pipe line ever built by private capital in America. Equipment will include 35 huge United 2-stage 10-inch and 12-inch Type MSE centrifugal pumps similar to those shown in service here at the Wichita Falls station of the Basin line. In conjunction with these, 13 United Type DVS single-stage pumps of the same capacity and half the tdh will be used. 18 United Type IL 16-inch booster pumps will supplement the service.

Like all United Centrifugal Pumps, each was specifically engineered and built to meet the precise requirements of its own job. When you specify maximum efficiency and dependability, look to United for this built-for-the-job performance backed by over a quarter-century of specialized service to the pipe line and processing industries.

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Fig. 1—(Left) Installing anodes with ditch digger. Fig. 2—(Right) Portable electric-motor-driven auger

Mitigation of Corrosion

of Bare Pipe Lines by Application of

Magnesium Anodes

by Robert L. Bullock

Fig. 3—(Left) Welding anode connecting wire to pipe line with Cadweld thermite welding kit. Fig. 4—(Right) Probe marker for locating connecting wire in testing performance of anodes

A NEW method of maintaining old bare pipe lines is being effectively applied by Interstate Oil Pipe Line Co. of Tulsa. The development of magnesium as a galvanic anode for cathodic protection purposes has made it possible to economically mitigate corrosion at localized "hot spots" on approximately 1,000 miles of old bare pipe line in Oklahoma. This new method, which has consisted of a mass installation of approximately 7,000 magnesium anodes, is believed to be the first of its kind in the pipeline industry.

The economics of the program, started in July 1947, was based on a plan of mitigation rather than one of preventing all corrosion. It was estimated that in the first few years it would hold the rate of corrosion leaks to the 1946-1947 level and in time show a decrease in the frequency of leaks. The results to date have justified the venture. These are reflected in savings from a reduction of corrosion leaks, oil losses, damages, and repair costs. The reduction in repair costs alone for the first 12 months of operation paid for the installation of approximately 85 per cent of the total anodes installed.

A salvage study of old, retired bare pipe lines showed that less than 5 per cent of the total pipe was corroded beyond future service. This fact pointed the way to an economical approach to the maintenance of old lines in that corrosion mitigation measures need be applied only to those sections experiencing corrosion. The location of the corrosive areas and the selection of measures to apply were factors which determined the feasibility of the program. A study of leaks showed that where leaks had been experienced, additional corro-

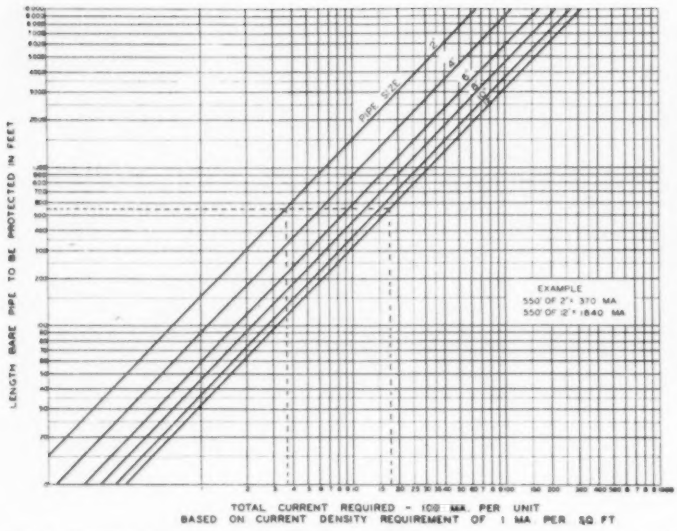
LENGTH BARE PIPE TO BE PROTECTED IN FEET
PIPE SIZE
EXAMPLE
550' OF 2" = 370 MA
350' OF 12" = 840 MA
TOTAL CURRENT REQUIRED - 100 MA PER UNIT
BASED ON CURRENT DENSITY REQUIREMENT OF 1 MA PER SQ FT

Fig. 5—Current-requirement curves, based on a current density of 1 ma. per sq. ft. of bare pipe

Robert L. Bullock is staff corrosion engineer for Interstate Oil Pipe Line Co., Tulsa. A 1931 graduate of Texas A. & M., from which institution he also received his M.S. degree in electrical engineering, he joined Humble Oil & Refining Co. in 1935. Two years later he was assigned on loan to Australasian Co. Pty., Ltd., in Melbourne, as head of geophysical exploration in Papua, New Guinea, remaining until 1940. He went with Carter Oil Co. in that year, working in the geophysical exploration department. He joined Interstate Oil Pipe Line in 1944, and was assigned to corrosion work in 1945.

sion leaks soon developed, indicating that leak records were a good way to locate hot spots on a pipe-line system.

The development of a magnesium alloy with a high driving potential and a fair efficiency (ampere-hour per pound of metal) has made it possible to apply cathodic protection economically to widely scattered sections of bare pipe. Since the program was designed to reduce corrosion at the points where it was being experienced, this type of cathodic protection was found to be ideal.

The mounting cost of making extensive permanent repairs and the ineffectiveness of permanent repairs in reducing corrosion leaks were factors which accelerated the adoption of the anode program for trunk pipe lines in Oklahoma. The program, briefly, consists of the following steps:

1. Installation of magnesium anodes at location of all leaks that had occurred since 1935.
2. Installation of magnesium anodes on all new leaks as they occur.
3. Discontinuance of extensive permanent repairs on serviceable trunk pipe lines.

The initial step of the anode program, the installation of anodes at all old leak locations, was started July 1947 and completed in January 1948. The locations of all old leaks were established by utilizing past leak records. Location of all leaks as indicated on leak reports since 1935 were plotted on cross-sectional paper. With this information as a guide, each leak location was investigated and the cathodic-protection requirement estimated. In this determination the following points were considered:

1. The number of anodes recommended by the leak graph which reflected the number of leaks at each location.
2. Length, size, and number of lines in contact with oil-saturated soil.
3. Serviceable condition of pipe.
4. Location of pipe where future leaks would present extreme hazard or extensive damage.

In order to complete the initial step of the program in as little time as possible, a type of packaged anode convenient for rapid installation, and proper equipment were procured. Every available company man was employed on the anode project. The packaged anode consisted of 17 lb. of magnesium and 27 lb. of especially prepared quick-setting backfill mate-

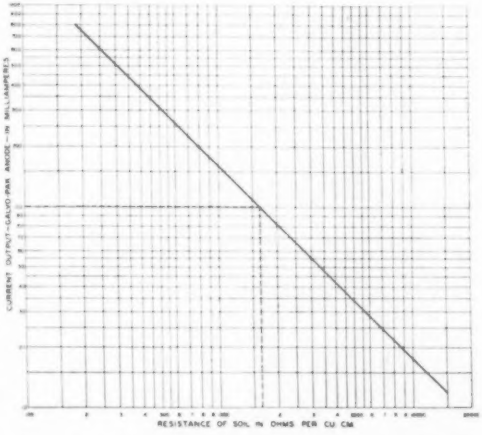

Fig. 6—Anode current output soil-resistance curve developed from field installations

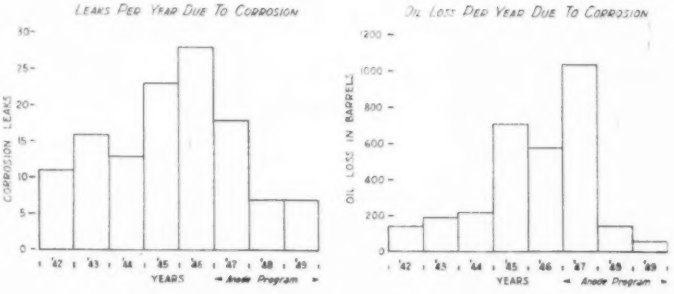

Fig. 7—Corrosion-leak and oil-loss study, Drumright to Glenn Pool system

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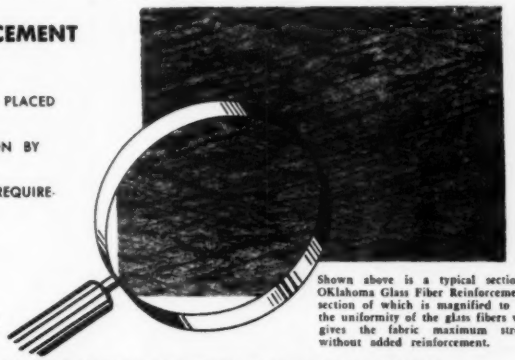

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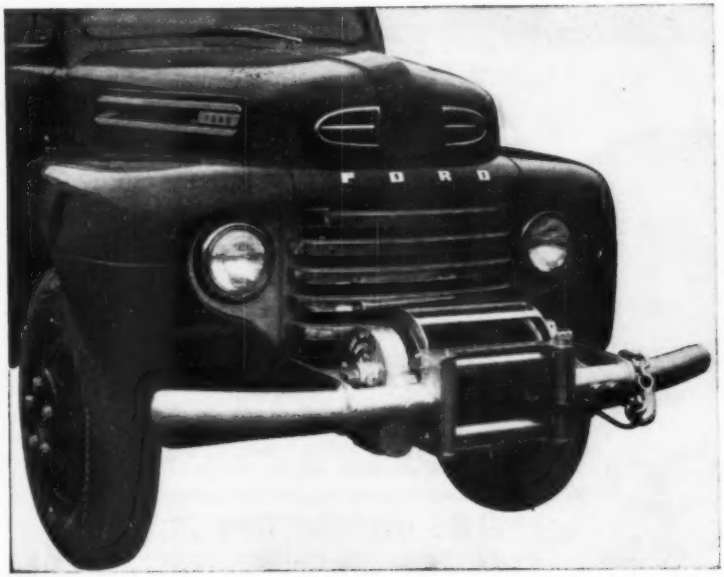

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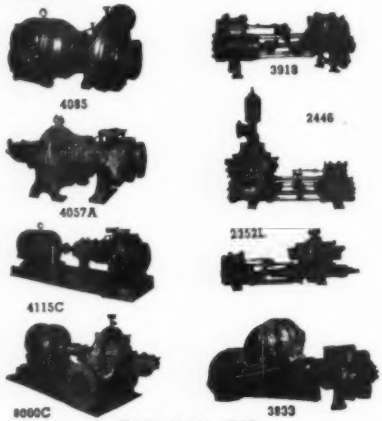

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rial packed in cloth sacks ready for installation. Jeeps equipped with augers as well as a power wagon normally employed for pole-line construction were put to use. A ditch digger (Fig. 1) was used to advantage where favorable terrain was experienced and a large number of anodes were installed. A portable electric-motor-driven auger (Fig. 2) proved to be ideal for digging holes in hard, compact soil. The ever-dependable post-hole auger was frequently used. Company field crews normally used for pipe-line maintenance as well as contract crews were employed to install the anodes.

Each installation was made with a definite plan of procedure. The anodes were placed from 2 to 6 ft. from the pipe line and as deep as practical. The connecting wire was welded to the pipe (Fig. 3) by the use of a Cadweld thermite welding kit. Each weld was coated to insure an insulated connection. An additional step was required for future testing of anodes. The surplus connecting wire was gathered and placed above the weld with a layer of dirt in between. A large rock (Fig. 4) was then placed over the wire to serve as a probe marker in locating leads for testing of installations. The rock was covered with dirt and placed below plow depth in cultivated fields.

A complete record of each installation, which included location of anodes as to station on the pipe line, spacing and soil resistance was recorded. The installation location was plotted on the leak-data chart for use in determining the effectiveness of the program. The resistance of the soil was used in estimating date anodes would be expended.

As the program progressed, new ideas were developed which improved as well as speeded up the work. A sketch showing various installation plans for single and multiple-line conditions was developed to aid the gangs in selecting suitable spacing patterns for installations and to simplify recording of locations. Each setting could be represented by a symbol, thus saving time normally required for making sketch of location. Curves (Fig. 5) representing length and size of pipe versus current required and a curve (Fig. 6) representing soil resistance versus current output of an anode were developed from field performance of magnesium-anode installations.

These curves, when used together, helped in determining the number of anodes necessary for a certain current density requirement. As an example, 550 ft. of 12-in. pipe located in soil averaging 1,700 ohm-cm., is to be protected with magnesium anodes. The current requirement curve (Fig. 5) for 12-in. pipe indicates that a current drainage of 1,840 ma. is required. The soil-resistance curve (Fig. 6) indicates that a magnesium anode will deliver 100 ma. in soil of

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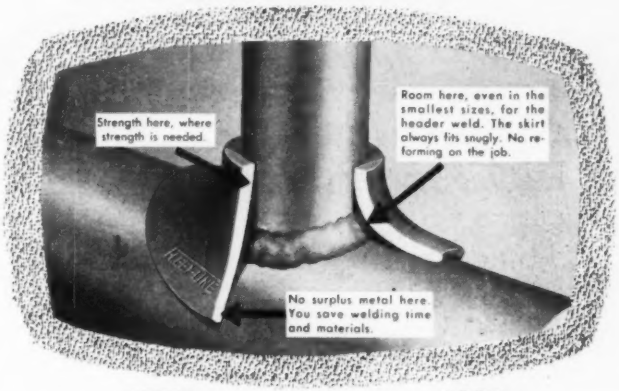
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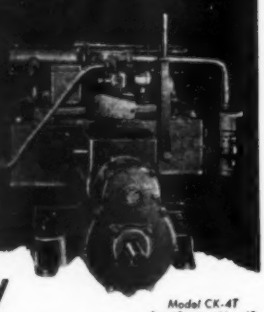

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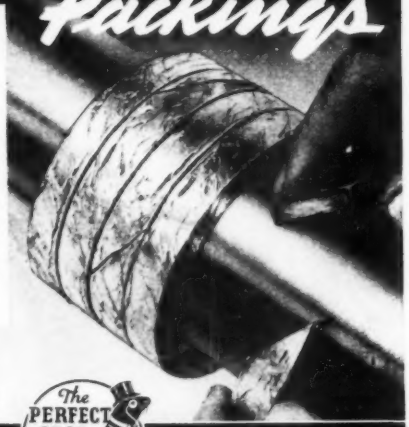

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1,700 ohm-cm. The total current required in milliamperes divided by the output per anode in milliamperes gives the number of anodes required, which in this case, is 19. If a current density of more or less than 1 ma. per sq. ft. is required, the number of anodes determined from the curves should be multiplied by the current density required.

The second step in the program, the installation of anodes at all new leak locations at the time leaks are repaired, has been vigorously maintained. Experience soon showed that an appreciable saving could be realized if anodes were installed at the time repairs were made. Every gang truck was therefore equipped with the essential materials necessary for a complete installation, so as to be prepared for emergencies.

It was found that anodes could be conveniently installed in the same hole excavated for repairs and that the placing of anodes close to the pipe (within 2 ft.) would concentrate the protective current on the area of pipe needing protection and thus reduce (end losses) the flow of current to adjoining areas. The number of anodes installed for a leak location depended on the size and number of lines, condition of pipe, resistance of soil, and the future status of the line.

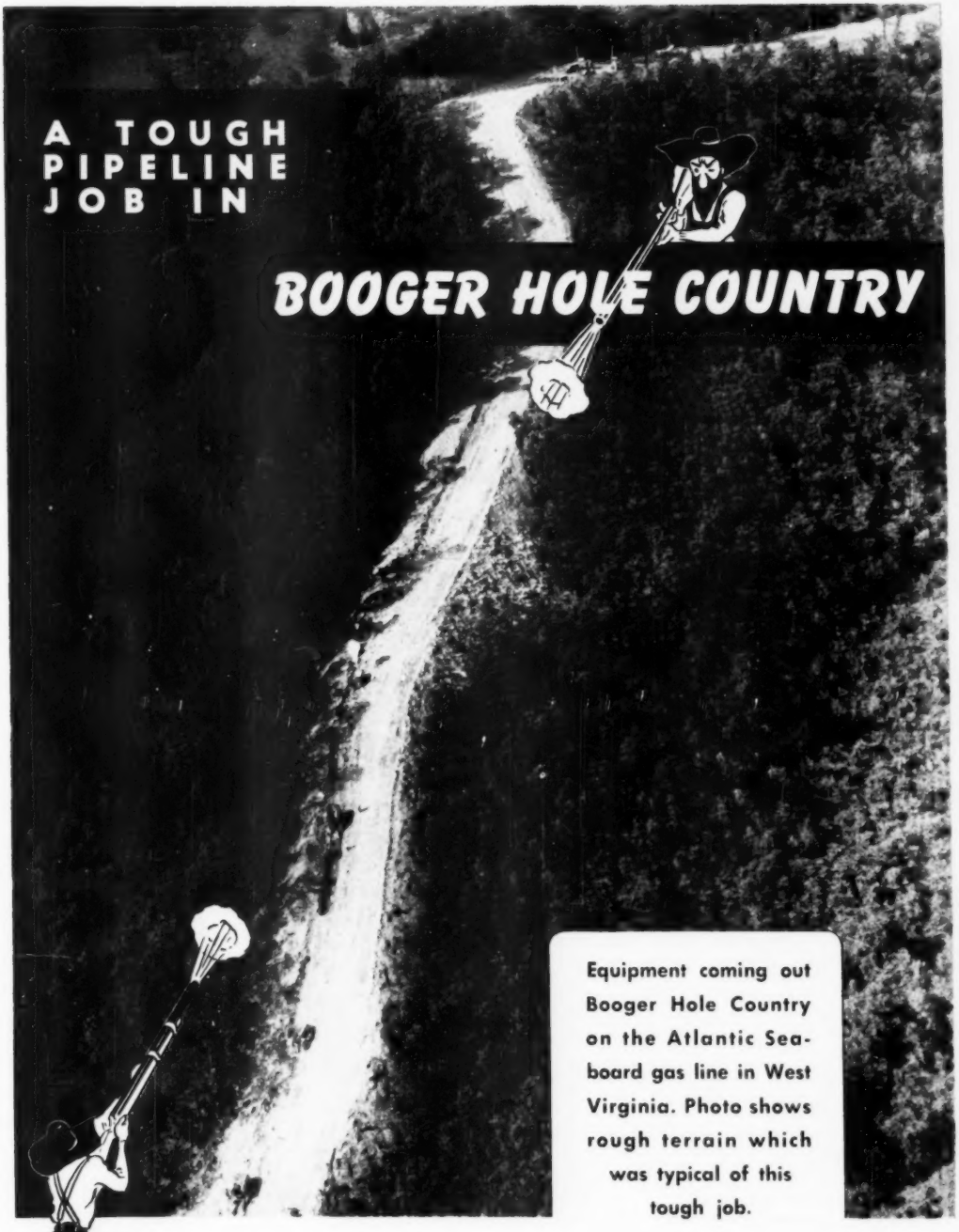
Trunk-line maintenance costs have been appreciably reduced. Since July 1947 extensive repairs to trunk lines have been limited to lines that are corroded beyond service, line washouts, alterations at highway and railroad crossings, rerouting of lines, and lowering of lines due to soil erosion and cultivation. Repairs to leaks have consisted of applying leak clamps or welding on patches and installing magnesium anodes.

The effectiveness of the anode program will be reflected by the reduction of corrosion leaks, oil losses, damages, and trunk-line maintenance costs during the next 10 years. The results at this early stage, however, are encouraging. Corrosion leaks experienced in 1947, as well as 1948, were approximately the same as in 1946. For the past 8 months the total number of corrosion leaks indicates that an appreciable reduction in leaks can be expected for 1949.

A corrosion study of the 8-in. multiple trunk-line system between Drumright and Glenn Pool, Okla., gives a very good example of the effectiveness of the anode program. This system, which has had a bad corrosion record, was laid in 1915, 1919, and 1923. Corrosion-mitigation measures applied in the past consisted of spot coating and spot reconditioning. A study of the leaks and oil losses due to corrosion from 1942 up to September 1949 (Fig. 7) indicates that on this system the anode program in the past 25 months has contributed to a 72 per cent reduction in corrosion leaks and a 60 per cent reduction in oil losses.

A TOUGH PIPELINE JOB IN

BOOGER HOLE COUNTRY



Equipment coming out Booger Hole Country on the Atlantic Seaboard gas line in West Virginia. Photo shows rough terrain which was typical of this tough job.

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Left: Hand wrapping pipe in high mountains near Summit. Right: Making crossings of Wolf Creek at elevation of 8,000 ft.

Mountains, Wasteland, and City Paving Posed Problems in Rangely-Salt Lake City Line

by John H. Henderson, Jr.

WHILE Rangely field, in western Colorado, was developed in the 2 years following the end of the war, The California Co., a subsidiary of Standard Oil Co. of California planned for the construction of a refinery in Salt Lake City and a pipe line to supply it with Rangely crude. Two new wholly owned subsidiaries, Salt Lake Refining Co. and Salt Lake Pipe Line Co., were organized to own and operate these new facilities.

The Wasatch Mountains, rising abruptly immediately to the east of Salt Lake City presented a tremendous natural barrier to a pipe-line route. Rangely is at an elevation of 5,150 ft. and Salt Lake at 4,200 ft. The lowest possible pass through the mountains is that used by U. S. Highway 40, with an elevation of 8,000 ft. Use of this pass would require an appreciable deviation from a straight line. The route finally selected for the pipe line, somewhat shorter in length, goes through the next pass to the north, Wolf Creek Pass, with a summit of 9,560 ft., 4,400 ft. higher than Rangely, 4,900 ft. higher than the lowest point to the east, and over a mile higher than Salt Lake City.

The line is 182 miles long with pipe of 10¾ in. o.d. by .307 and .250-in. wall thickness. Pump-station discharge pressure is 1,450 psi. There are two pump stations, giving capacity of 22,000 bbl. per day, which can be increased substantially by the construction of a third pump station.

The route of the pipe line passes through a great variety of terrain—from desolate wasteland, to paved city streets where perhaps 20 small gas and water lines per block were encountered.

With the exception of a few miles of irrigated farming land near Myton, Utah, the first 87 miles of the route are open, sage-covered country, broken by rocky ridges, five river crossings, and a virtual cliff near the Colorado-Utah border. Between mileposts 87 and 116, the route winds through the picturesque, narrow Duchesne Valley, almost entirely in irrigated farmland, crossing the Duchesne River several times. The intermediate pump station, near Hanna, is located within this section.

The next 17 miles of the route, all above 7,000 ft., is through grassy meadows, virgin pine forests, rocky ridges, aspen thickets, and rock slide areas. Wolf Creek Summit, at 9,560 ft., is in this section.

For the succeeding 9 miles, the route passes through farming land, to Rhodes Valley, where plowed fields were found to be underlain with solid rock at a depth of about 1 ft.

From a construction viewpoint, certainly the most difficult portion of the line lay between mile post 142 and Salt Lake City, where only per-

John H. Henderson, Jr., design engineer for Standard Oil Co. of California, and project engineer for the Rangely-Salt Lake pipe line, is a native of El Paso, Tex., who graduated with a B.S. degree from University of California in 1942. Two years later he spent another year at University of Michigan while on duty with the Navy during the war. He went to work for Standard of California in 1947. Henderson brought to the Rangely-Salt Lake pipe-line job experience gained during design of the 61-mile Abqaiq-Ras Tanura crude-oil line in Saudi Arabia. He is project engineer for the products pipe line Standard is building from Salt Lake City to Boise, Idaho.

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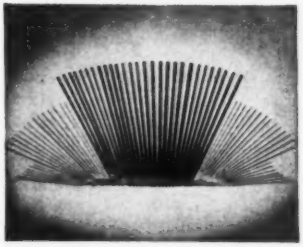

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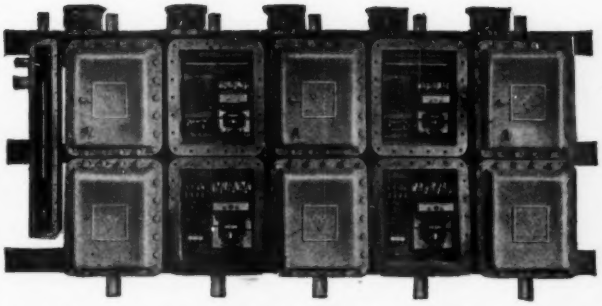

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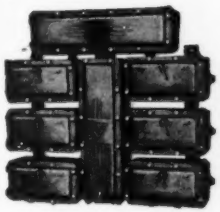

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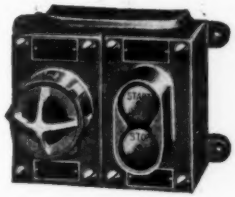

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Left: Typical country near Colorado-Utah border. Right: X-ray equipment for inspecting welding

haps a total of 5 miles were even what might generously be called "rolling." The crests of the hills were almost invariably rocky, and in most cases the rock was not confined only to the hilltops. It was here that the stringing trucks had to be towed by tractors for 5 miles in some places, where ditching machines were let down the steep slopes at the end of wire rope, often with two tractors as an anchor. It was also here that thousands of feet of trench were dug by hand, on rock slopes where even tractors couldn't go—let alone ditchers and back hoes. These hills weren't what would be called mountains, for the difference in elevation between a crest and the adjoining valley would rarely be over a thousand feet —but it was also rarely under 500 ft., all of it steep, most of it rocky, none of it routine.

For the final 10 miles before the line enters Salt Lake, it passes down through historic Emigration Canyon, through which the first party of Mormon settlers passed, and emerges into the level near the famous "This Is The Place" monument. From here the route passes through Fort Douglas, down a residential street, within 800 yards of the State Capitol, and on to the refinery, just north of the city.

Preliminary work — layout of the line, survey, and acquisition of rights of way—took place for the most part in the summer and fall of 1947, and construction of the trunk line and pump stations was started in the early summer of 1948.

The contract for line construction was awarded Pacific Pipeline & Engineers, Ltd., who started construction as soon as substantial quantities of pipe became available. X-ray inspection of welding was performed by Industrial X-Ray Engineers. A large pipe-line spread commenced laying pipe at Rangely on June 25, 1948, and several smaller spreads commenced work at various locations between the Summit and Salt Lake City July 1, and at intervals thereafter. The extreme ruggedness of terrain prohibited a single large spread from operating in this mountainous, rocky country; the inevitable delays would have been too costly. At elevations where tractors seemed to have a small fraction of their rated power, hindered by large trees and boulders, it was not unusual to view, from the air, construction going on in many places. On August 12, the writer noted welding taking place in eight different locations, and ditching in six; a month later, welding was in progress in seven places, ditching in six. However, in spite of all delays, timber, rock, and high elevations, the last tie-in weld was made October 4, less than 3½ months after the first joints were lined up.

As examples of the type of terrain encountered, the following elevation differences show at various places on the profile of the line: 9,560-8,000 ft. in 2 miles; 8,400-7,400 ft. in 1 mile; 7,800-6,600 ft. in 2 miles; 6,400-7,200 ft. in 1 mile; 7,050-4,200 ft. in 16 miles.

The hydrostatic pressure of Rangely crude increases at the rate of 371 psi. per 1,000 ft. difference in elevation, and at 434 psi. for water. With these localized elevation changes, it was impossible to run scrapers with water after construction, even using the largest portable pumps. So, the main line pumps at Hanna were "broken in" by pumping water for several days.

There was an extreme lack of railroads for the greater portion of the route. The eastern 42 miles of pipe were hauled from the closest railhead to the east, Craig, Colo.—an average haul of 115 miles. At mile post 42 the crossing of the Green River, no bridge capable of supporting heavy equipment existed for 25 miles upstream and 80 downstream. Accordingly, pipe laid west of this point was hauled from Heber, Utah, 123 road miles to the west. All somastic-coated pipe was hauled from the railhead somastic plant near Heber—a maximum haul of 194 miles to Rangely.

The pump-house building and the maintenance garage at each station are constructed of concrete blocks with Transite roofs. At Rangely station there are a concrete-block office-warehouse building, six cottages and a bunkhouse. At Hanna there are two cottages and a bunkhouse. Pumping equipment consists of three National Transit double-acting duplex plunger pumps driven by 9-in., eight-cylinder super-charged Nordberg engines. At Rangely the engines are gas-diesels, burning crude and dry gas from the new natural-gasoline plant; at Hanna they use straight crude.

A gathering system at Rangely, consisting of a total of 21 miles of 4, 6, 8, and 16-in. pipe, a modern terminal at Salt Lake City, and a radio-communication system complete the facilities.

Rangely station began operation November 12, and crude reached Salt Lake City on November 19—shortly before the start of one of the most severe winters in local history. A complete cycle of weather and temperature has almost been completed, with no operating difficulties in any portion of the system.

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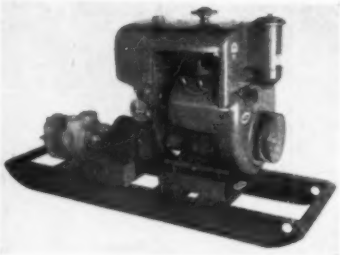

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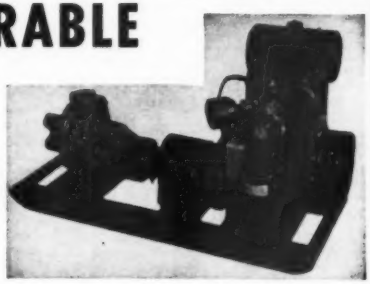

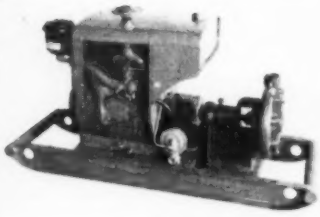

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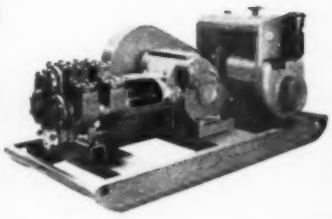

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Automatic Control and Operational Devices

. . . . that improve efficiency and shave expense in operation

by M. C. Callahan

IN the modernization of facilities utilized in the operation of a pipe-line pumping system, much progress has been made, especially in automatic control and operational devices which have some times been put to uses other than originally intended by their manufacturers. In many instances they have been revised to meet special requirements. Furthermore, like other electrical departments in the oil industry, we have found it necessary to create pieces of equipment which have increased efficiency, subsequently lowering operating costs.

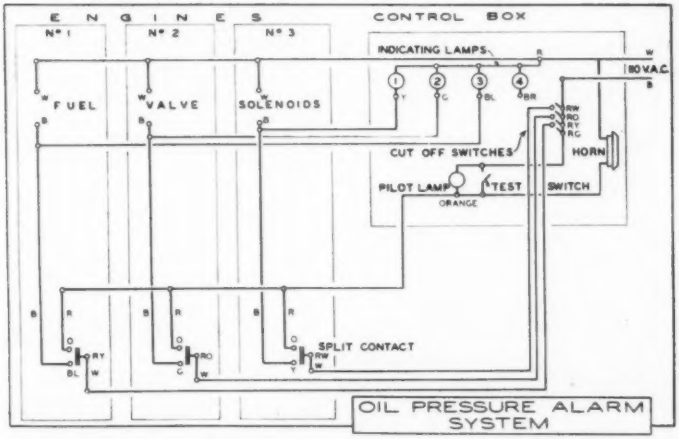
Wherever possible we have taken advantage of equipment which by trial has proved to be of benefit to insure continuous operation of pipeline pumping equipment. Shutdown time in pumping stations is a cost item which cannot be recovered.

Many factors are involved in the economic and efficient operation of a pump station. One of the important features is the lube - oil - pressure alarm system for diesel engines. It is well known that constant lube-oil pressure must be maintained for proper lubrication. Since it is almost impossible for the operating personnel to be aware of changes in lube-oil pressure at all times, it was necessary to provide automatic engine-shutdown control when lube-oil pressure reached the lower danger point which we consider to be between 3 and 4 lb.

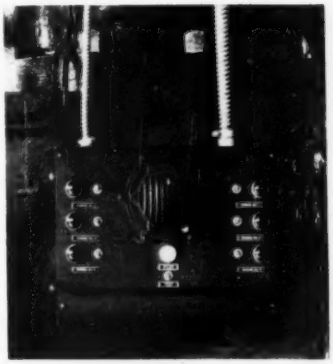
The automatic system which we have installed correlates three control mechanisms that are combined in the warning and shutdown system for each engine, with the necessary interconnecting wiring as shown in Fig. 1. The indicating control panel can be equipped for any number of engines desired. The control panel indicates by signal lights which engine is losing pressure and an audible signal circuit is energized at the same time.

The component parts of the low lube - oil - pressure safety shutdown system consist of: One safety control panel, 115 volt, 60 cycle equipped with one Type M Vibratory howler (for any specified number of engines). One special pressurestatic split contact maker, (operating on 3 to 15-psi. pressure range), and one normally latched-open solenoid fuel valve, maximum pressure 150 psi., 115 volts, 60 cycle. The latter two units are mounted on each engine and electrically connected to the control panel which is located in a place easily seen by operating personnel.

Since the lube-oil pressure is maintained at 15-psi. maximum pressure and we consider 3 to 4 psi. to be the low-pressure danger point, the pressurestatic contact maker is set to make contact on split-circuit contact points at law-range setting. When this action occurs the visual and audible electrical circuit is energized to the indicating control panel and to the normally open-latched fuel valve which immediately closes. After fuel valve closes, the engine will run approximately 30 seconds on fuel oil remaining in lines and fuel pan. During the elapsed time between the audible signal and actual stopping of the diesel engine the operator has time to build up pressure by hand pump and latch the fuel valve open, for continued operation. If unsuccessful the engine will shut down as originally intended through the pressurestatic contact maker which will not open until sufficient pressure is reached.



Left: Schematic diagram of lubricating oil-safety alarm



Above: Indicating control panel installed on diesel engine for lubricating alarm system

The Author

M. C. Callahan is superintendent of the telephone and telegraph department of the Tulsa pipe-line division of Gulf Refining Co. He joined the electrical and communications department of Gulf Pipe Line Co. in 1928. He was located as Seminole, Okla., district until 1931, when he was transferred to the Missouri district at Springfield. In 1936 he was transferred to the New Mexico district at Hobbs and to Tulsa in 1940. He was named to his present position in 1942.

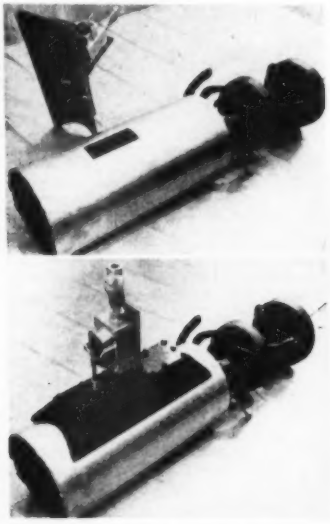
The unit described has been installed on all vertical diesel engines in the Tulsa division pipe-line system, and is but one of the many devices which is performing successfully in insuring the most economical and continuous operation of our pumping system.

Scraper Arrival Signal

Another device which has proved economical and efficient is the scraper-arrival signal. Scrapers moving through crude-oil lines cut loose certain amounts of paraffin. If this paraffin is allowed to pass into the venturi meter lines it would plug the meter tubes and render them useless until cleaned.

Since the meter is usually bypassed awaiting scraper arrival, a careful watch must be maintained for scrapers so that receiving meters can be placed in operation without delay. A great need was felt for a signaling device that would inform station personnel of scraper arrival. This device would free personnel for other tasks around the station and decrease out-of-service time for the receiving meter.

To eliminate this problem a rectangular blister was welded on the scraper receiving line between the valve and scraper trap. On the portion of line covered by the blister a 1 by 6-in. slot was cut, running lengthwise along the pipe. Attached to the blister seal plate is a hinged paddle. The hinge allows the paddle to hang through the slot into the pipe. A shaft is mounted vertically in such a position as to be pushed upward actuating any desired signal switch when scraper passes signal point.



Scraper arrival signal device

Both toggle and mercury-tube switches in explosionproof enclosures are in use. They are electrically connected to any desired form of audible or visual signal in the pump station.

Further changes have been made to this general design for use in high-pressure lines. Favorable tests have been made for working pressures up to 1,200 psi.

The results of both models have been outstanding in that no failures of operation have been noted since installation in 1947.

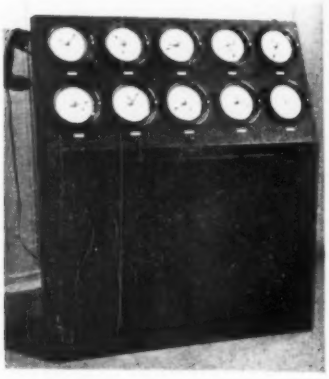
Selsyn Tank Gages

A great number of oil companies have economized on station operation through the installation of remote-reading automatic electric tank gages. Most of the gages manufactured give a continuous remote reading of oil level in tanks with an accuracy of within ⅛ in.

Because of economy of maintenance and simplicity of design and installation we have concentrated on the Selsyn motor device. An identical Selsyn motor is utilized in both transmitter at the tank and receiver units located in pump station and operates efficiently on a range of 105-125 volts a.c., 60 cycles. Very little maintenance is required on this installation. Since the transmitter and receiver unit motors are identical, by following coded wiring a spare motor can be inserted by station crew when necessary.

Our most recent installation is located at new Perryman pump station located southwest of Jenks, Okla. In this installation we have incorporated new designs in explosionproof housings for transmitter motors at the tanks, aerial-cable spiral-tape wound to galvanized-steel messenger wire, and a special receiver cabinet in which all power and connecting cable terminations are mounted on a concealed panel. To facilitate resetting of gages in case of a prolonged power failure we have included a sound-powered telephone handset on the receiver cabinet and have provided a telephone jack at each tank transmitter in which the check gager can plug in a small portable handset telephone.

The installation of automatic electric tank gages eliminates hourly hand-gaging time except for hand-gage checks several times daily.



Remote indicating receiver panel

Screen to guard switchboard to prevent contact with knife switches

Installation at 55,000-bbl. tank at Gulf Refining Co.'s Perryman station, Oklahoma: 2-in. riser for counterweight guard is utilized as hanger for service cable

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(Above) Two Trackson MD8 PIPE LAYERS on Caterpillar D8 tractors cradling the "Biggest Inch" on coating and wrapping operation in the hills back of Hollister, Cal.

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MAINTENANCE OF PIPE-LINE ENGINES

Here's a four-point check system which will circumvent the most common troubles, and show greatest savings in the shortest time

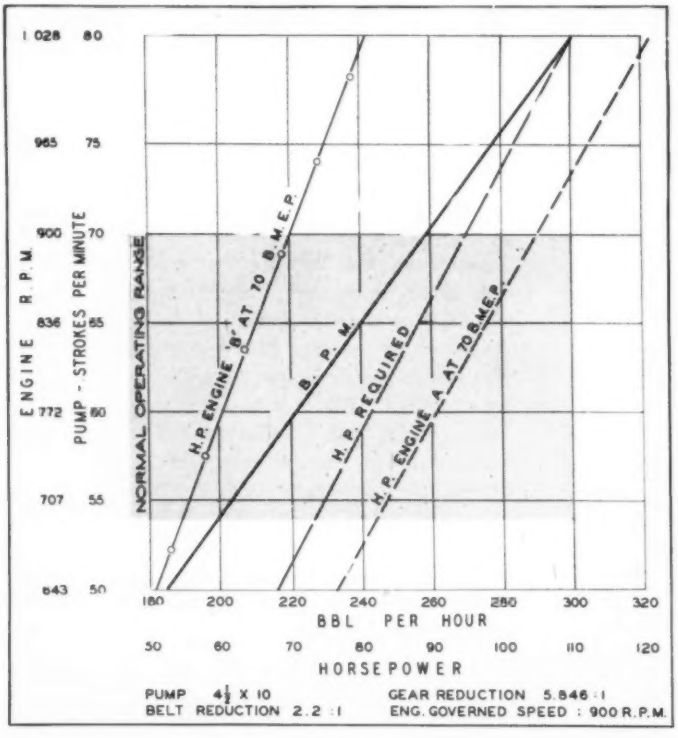
by Joe L. Cahill

ANY satisfactory maintenance program for pipe-line engines begins when the engine is selected. Varying power requirements, particularly in gathering-line service, make sizing engines a problem requiring much study; but judicious selection results in lower maintenance cost per horsepower as well as longer service life.

In some places where load variations cover wide ranges two units are used, one for the average load and a similar one for "peak power." In most cases these units can be of equal size and rotated to approach conditions of equal wear. Use of reciprocating pumps also allows the use of speed variation within certain limits to maintain load and engine output within narrow economical ranges. Perhaps one of the greatest enemies of good preventative maintenance in gathering systems is the tendency to oversize power units in anticipation of heavier loads or the attempt to save money using one unit where two are indicated.

To describe adequately a complete maintenance procedure in the space allotted would be impossible; consequently this article will attempt to cover only four points which in the author's opinion are most frequently neglected and which can show the most spectacular savings in the shortest time and which are possibly the least variable in a general maintenance program. These four points are (1) engine lubricating system, (2) engine cooling system, (3) automatic control equipment, and (4) engine tuneup and accessory lubrication.

It is axiomatic that no internal-combustion engine is better than its lubricating system. Also, while most engine manufacturers are reluctant to specify a definite lubricating-oil change period, they sometimes recommend one calculated to be favorable to their engine. This, of course, ap-



To further illustrate the points mentioned under "Engine Selection" this chart shows two engines tentatively selected to power a pump on a branch gathering system. This system is so constructed that pumping rates at one battery have to be reduced periodically to let smaller pumps into the line. This is usually accomplished by opening the bypass and recirculating the fluid. It readily can be seen from the chart that should this be done much power would be wasted and the engine would be loafing. If, instead, the governor or throttle setting were changed the engine power output would more nearly match the requirement resulting in fuel and operating economies. This is not nearly so important when free gas is available, but when other fuels are used or gas must be bought the savings are appreciable. A chart of this nature could be constructed for each size pump used and the horsepower curves of different engines calculated and superimposed when power units were to be bought or replaced

Joe L. Cahill, chief engineer of Continental Oil Co.'s pipe-line department, Ponca City, Okla., is a native of Fall River, Mass., and a mechanical engineering graduate of St. Dunston's University, Prince Edward Island, Canada. He started with J. & L. Machinery & Engineering Co. of Providence, R. I., and since then he has been engaged in research, designing and construction. During the war he participated in the Seabee program by designing portable equipment for overseas shops and in designing power tools for use under battle conditions. He helped to develop the 20-mm. antiaircraft cannon for the Bureau of Ordnance and did special work for the Bureau of Ships. He served as design and sales engineer for Diesel Power Co., Tulsa, before joining Continental in September 1948.

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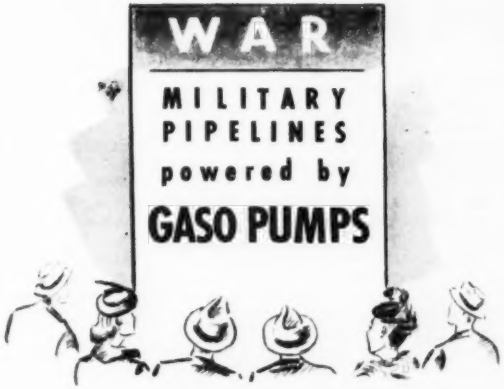

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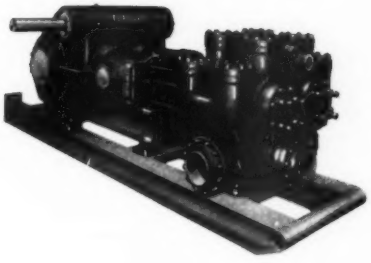

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plies mainly to the small automotive-type units used in field gathering systems, the larger units sometimes running at long intervals between overhauls and oil changes. Services of lubricating engineers are available to all pipe lines and by the intelligent use of laboratory facilities lubricating oil life may be extended in some cases to three and four times engine manufacturers' recommendations.

It must be realized, however, that lube-oil filters play an important part in lube-oil maintenance and once a filter-change schedule is set up by the laboratory it must be rigidly followed. Otherwise all benefits are lost and a burned-up engine may result. It has been the author's experience that increasing filter capacity to 20 per cent of full flow is instrumental in increasing lube-oil life.

Another frequently ignored cause of crankcase contamination is improperly operating breathers. Where dusty or dirty conditions prevail, oil-bath breather caps are indicated. In any case daily inspection of the crankcase breather will materially assist the maintenance of long lube-oil life.

A very important, but sometimes neglected, adjunct of proper lube-oil maintenance is adequate cooling-system treatment. Proper cooling-water temperatures with low differential and adequate descaling treatment will go a long way toward preventing sludge and water contamination in the lube oil. Many devices are available for maintaining proper differentials.

The three-way proportioning valve, thermostatically controlled, is perhaps most popular. On radiator-cooled engines the bellows thermostat in the water outlet from the block is almost universally used. This type of control has many faults and close observation is necessary to insure proper operation. For general pipe-line engines, water-jacket temperatures of 160° to 180° F. with 5° to 10° F. differential have been found adequate; however, in some engines equipped with heated crankcases and pressure cooling systems temperatures of 200° to 212° F. have been very successfully used.

No discussion of cooling-system maintenance would be complete without rust and scale inhibitors. Rust and scale within the cooling system destroy any control over temperatures by changing the heat-transfer characteristics within the water jacket, and building up heat within the engine which is not indicated on the engine thermometer. In addition, it shortens the life of the water pump and may block off parts of the cooling system entirely. There are many preparations on the market to prevent the formation of this rust and scale some, naturally; are better than others. Sodium and potassium chromate has been used successfully in many cases and has the advantage of being cheap as well as almost universal. There are some conditions which do not yield to this compound and in these cases a particular treatment is indicated. This treatment can be obtained from any one of a number of firms specializing in water treating. Use of properly inhibited distilled water in cooling systems, were it practical, would be the best solution. However, analysis of the water used and continued use of water from the same source will indicate the amount of chemical treatment necessary to maintain nearly scale-free conditions.

Electrically operated control equipment installed on some engines to shut down the unit in case of excessively high water temperature and low lube-oil pressure, or high or low line pressure, needs constant attention. One of the greatest faults of this type of equipment is that every operator relies on it and yet never thinks of it. In general, these controls operate by moving contacts coming together under predetermined conditions, and numerous engine failures have been recorded due to their failure to operate at the proper time. Corrosion of the terminals has been the major cause of such failures. Proper maintenance of such controls demands they be tested each time a unit is started or in case of a constantly running engine they should be used to stop the engine once each day. In this way the operator can detect mechanical faults or terminal and contact-point corrosion in time to correct it before damage can be done through failure of the equipment to operate when needed.

Periodic engine tuneup is another neglected source of trouble in many pipe-line installations. Simple tuneup is usually within the abilities of the operator and does not require the services of a mechanic. Proper adjustment of carburetor or injectors, timing, fuel-injection systems, fan belts, generator drives, etc., are small things in themselves, yet, when neglected, hide the danger signals which indicate the approach of major trouble as well as raising the cost of operation by diminishing the efficiency of the engine. Starters, generators, water pumps, power takeoffs, and other accessories should have definite periodic lubrication and inspection periods.

By establishing proper and peroidic procedures for incorporating the above points into standard maintenance it becomes easy to detect variations from normal performance which indicate major troubles before they become serious enough to cause station shutdowns.

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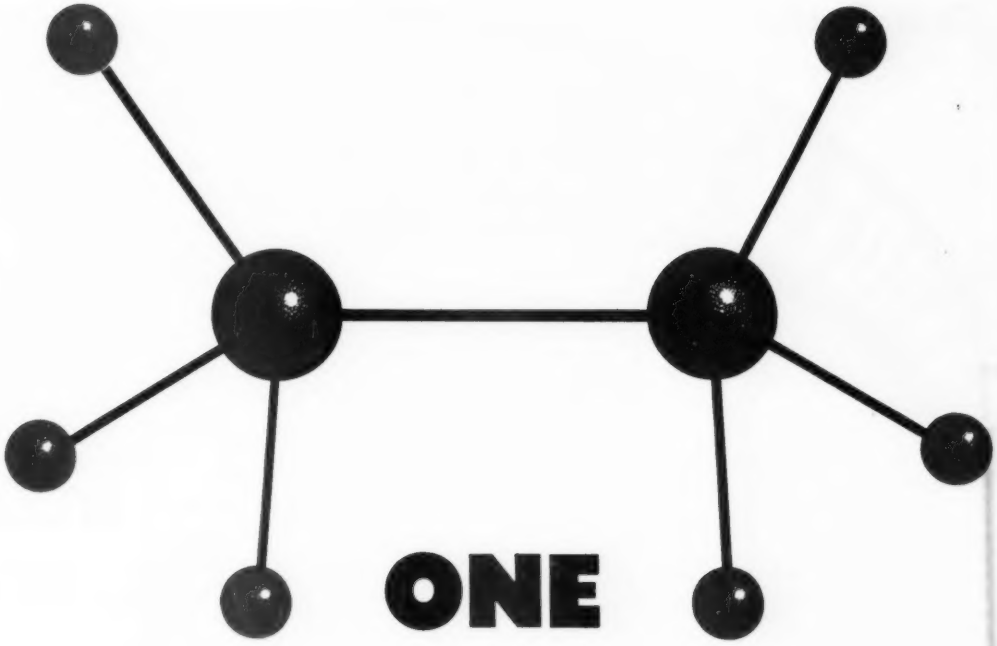

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SMOOTH BENDS in 26-in. HIGH-CARBON THIN-WALL PIPE

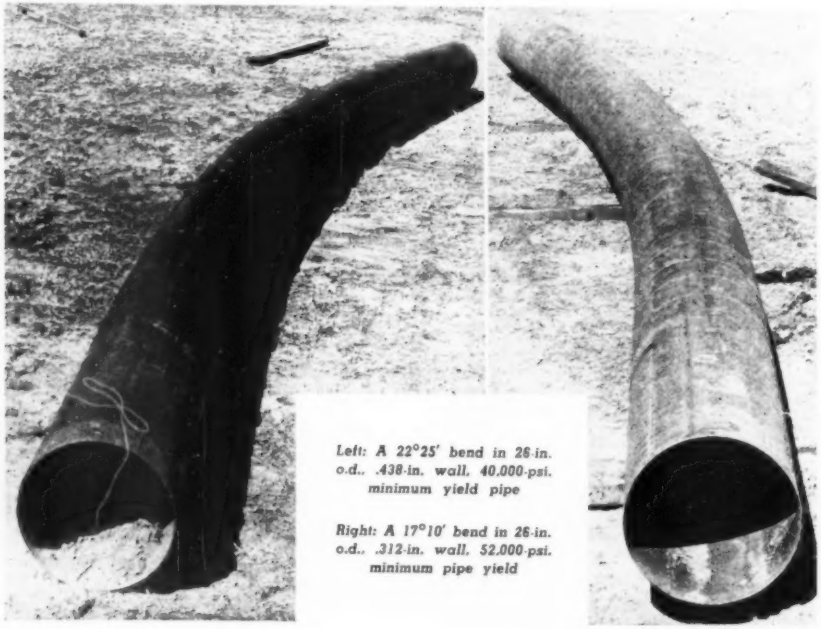
by Russel W. Hofsess

Russel W. Hofsess is associated with Cities Service Co. as operating engineer, with headquarters at Oklahoma City. He has been with the company since 1933, his positions ranging from field timekeeper to his present position. He is a graduate of Kansas State College, where he obtained his B.S. in civil engineering.

UNTIL recently, the two best known and accepted methods of changing direction in large-diameter, high-carbon, thin-wall pipe used in high-pressure gas lines, have been (1) the welding in of factory-made bends, and (2) wrinkle-bending the pipe on the line. Smooth stretch-bending of smaller-diameter, low-carbon pipe with various devices and machines which made very little or no change in the wall thickness of the pipe on the inside of the bend, but thinned the pipe wall on the outside of the bend, has been common practice for years. However, for larger-diameter, thinner-wall, higher-carbon pipe the smooth stretch bend has not proved practical, because of the reduction in pressure carrying capacity due to thinning the pipe wall. Also, there was difficulty in making a smooth stretch bend of any appreciable degree in the thin-wall, high-carbon pipe, without collapsing or buckling.

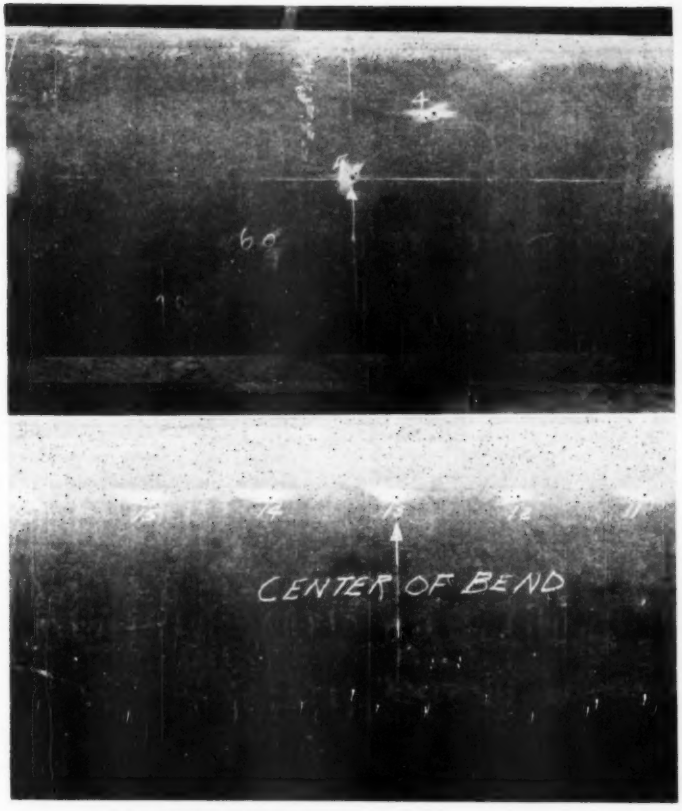
Cities Service Gas Co. has used both the factory-bend and wrinkle-bend methods in laying 26-in. high-pressure lines, but has experienced difficulties with both methods. However, in 1948, the wrinkle-bend method was considered the more desirable of the two for use in construction of the 395 miles of 26-in. line from Kansas-Hugoton field to Kansas City, and that method was used on the 265 miles laid in 1948. Construction on the remaining 130 miles was scheduled to begin in May 1949, and specifications called for wrinkle-bending on that section also.

In February 1949 the recently developed hydraulically operated smooth-bending machine came to the attention of Cities Service executives and engineers. Three of the machines had been built at that time, which had been used on up to 22-in. diameter, heavier-wall pipe, used for oil lines, and a machine had been equipped for, and tests made in the yard by the manufacturers on 26 and 30-in. thin-wall, high-carbon pipe. Claims of the designer and manufacturer were that the pipe to be bent was clamped in the machine by hydraulically operated clamps, then bent around a die, or shoe of fixed radius (the radius being 20 diameters of the pipe), by a hydraulically operated shoe, or "stiff back." The shoe was so set and actuated that the pipe was bent in compression, both on the inside and outside of the bend, producing a bend by upsetting or increasing the wall thickness of the pipe on the inside of the bend, and without decreasing the wall thickness on



Left: A 22°25' bend in 26-in. o.d., .438-in. wall, 40,000-psi. minimum yield pipe

Right: A 17°10' bend in 26-in. o.d., .312-in. wall, 52,000-psi. minimum pipe yield



Top: Showing 3/16-in. holes for measuring wall thickness on outside of bend
Bottom: Showing 3/16-in. holes for measuring wall thickness on inside of bend

the outside of the bend. It was claimed that in some cases even the outside wall thickness had been slightly increased.

Early in March 1949 arrangements were made for the manufacturer to bring a machine to Cities Service Gas Co.'s yard in Wichita, Kans., to make test bends on 26-in. pipe, to determine the practicability of using this method of bending on the remaining 130 miles of the Hugoton-to-Kansas City 26-in. line. Pipe used in the tests was taken from stock piles of pipe to be used in the line construction, and consisted of 26-in. o.d., 0.3125-in. wall, 52,000-psi. specified minimum yield, and 26-in. o.d., 0.438-in. wall, 40,000-psi. specified minimum yield, A. O. Smith pipe.

The two primary objectives of the test to be made were: (1) to determine whether the machine would make a smooth, round, acceptable bend of the required maximum degree, practically and consistently under field conditions, and (2) to determine the effect the bend would have on the physical properties of the pipe metal and the pressure carrying capacity of the bent pipe. Tests to accomplish the first objective consisted of bending a 40-ft. joint of each wall thickness to approximately the maximum degree, in the manner in which it would be done on the line.

Design of Machine

The machine is so designed that the maximum bend obtainable with one push of the movable shoe is approximately 4°, but on pipe of this size and physical properties, it was found that from 1° to 1½° per push was the maximum obtainable without wrinkling the pipe on the inside of the bend. To obtain bends of near maximum degree in a 40-ft. length, a series of bends was made by moving the joint through the machine at increments of from 12 to 18 in. and applying the bending pressure at each successive move. In this manner, a smooth, symmetrical, continuous-appearing bend of approximately 0.5° per foot of pipe was obtained on both weights of pipe tested.

The time required to make the bends was slightly greater than in the wrinkle-bend process. The machine appeared to be rugged, well built, and capable of continuous trouble-free operation.

To determine the effect of bending on the physical properties of the pipe metal and the pressure carrying capacity of the bent pipe, bends were made in 6-ft. sections near the ends of joints of each weight pipe. Theoretically, successive bends or pushes, even at close increments, do not affect the adjacent bend, and to obtain

Smooth bends made on line. Pipe is 26-in. o.d. .312-in. wall, 52,000 psi. minimum yield

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maximum effect on the pipe wall, it was only necessary to make bends of one maximum push of the machine. However, to insure best results the test bends were made with a minimum of three pushes at close increments, producing bends from 4½° to 6⅔° in 6 ft. of pipe.

To measure the wall thickness before and after bending, ⅞-in. holes were drilled, before the pipe was bent, on 8-in. centers along the horizontal axis of the pipe on what was to be the inside of the bend, and on a diagonal line beginning on top of the pipe at one end of the section to be bent, and extending 180° around the pipe to the other end of the section on what was to be the back, or outside, of the bend.

A comparison of micrometer measurements taken through these holes, before and after bending, showed an average increase in wall thickness of 0.0008 in. on the 0.3125-in. wall pipe on the outside of the bend and 0.0025 in. on the inside of the bend. On the 0.438-in. wall pipe there was no apparent change in wall thickness on the outside of the bend and an increase of 0.0064 in. on the inside.

Effect on Wall Thickness

To verify further the effect on wall thickness, both transverse and longitudinal coupons were cut from the pipe at points of maximum bend on the inside and outside, and from corresponding locations on the unbent portion of the joint. A comparison of micrometer thickness measurements of these coupons showed no decrease in wall thickness on the outside of the bend and slight thickening on the inside of the bend. These results checked closely with the measurements taken through the ⅞-in. holes.

The transverse and longitudinal coupons were machined for tensile specimens and tested in the laboratory to determine change in physical properties of the metal due to bending. The longitudinal specimens from the bent sections showed an increase in yield strength and a corresponding decrease in ductility, due presumably to cold working the metal in the bending operation.

Results of the above tests indicated no material change in the pressure-carrying capacity of the pipe due to bending.

Outside-diameter measurements were also taken at close intervals on both the full-joint bends and the short test sections, to determine flattening of the pipe due to bending. Average flattening on the full-joint bends was 0.303 in. on the 0.3125-in. wall and 0.331 in. on the 0.438-in. wall pipe. On the short sections the average was 0.437 and 0.39 in. respectively, with a maximum observed flattening on any bend of 0.53 in. This was scarcely noticeable visually, and presumably would not interfere with the

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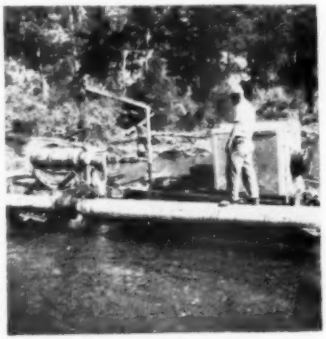

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machine painting and wrapping operation, or the installation of river weights and emergency sleeves.

Results of all tests were favorable and the decision was made to use this type of bend on the remaining 130 miles of line to be laid in 1949. The contractor purchased the first available machine equipped for bending 26-in. pipe, and started construction 20 miles northeast of Hutchinson, Kans., in May 1949.

The machine came from the factory skid mounted, but was considerably heavier than machines previously used, and to facilitate moving it along the right-of-way, the contractor mounted it on a track wagon of the type commonly used for hauling heavy loads over soft ground, and found it worked very satisfactorily.

The only mechanical trouble experienced to date with the machine has been the failure of one hydraulic cylinder, which was replaced by the factory without delay, and a few minor structural cracks in the welded framework, which were readily rewelded and reinforced on the job.

As of August 15, approximately 100 miles of the line have been completed. That portion across the Kansas Flint Hill country probably required more bends per mile, and bends of greater degree than would any other location in Kansas, but the bending operation has stayed out ahead of the lineup without difficulty.

The degree of bend obtainable is, as was indicated by the yard tests, approximately 1° per push of the machine, and 20° can be made in a 40-ft. joint very satisfactorily. The cleaning, painting, and wrapping machines pass over the 20° bends without difficulty and there has been a minimum of hand painting and wrapping required.

Smooth, round, satisfactory bends were obtained from the start of the job, and in the 100 miles laid to date, there has been only one buckled bend to be cut out and charged to the contractor.

Several other major companies are now using this process of bending on diameters up to 30 in., and it appears to be the major improvement in large-diameter line construction methods in several years.

BOOKS

STRATIGRAPHY AND PETROLOGY OF BUCK HILL QUADRANGLE, TEXAS. By S. S. Goldich and M. A. Elms. Published by Bureau of Economic Geology, University of Texas, Austin. 50 pp. 50 cents.

This report is accompanied by six figures and six plates, including a geologic map in color. The Buck Hill quadrangle is a favorable area for detailed studies of the Tertiary stratigraphy and petrology of the southern Davis Mountains, and this report is the culmination of field investigations carried on in 1936 and 1940 with additional work in 1946. An appendix contains nine detailed measured sections in the quadrangle, and numerous chemical analyses of rocks in the area are included in the text.

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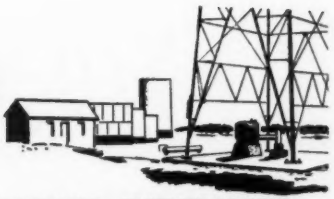

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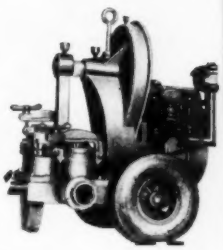

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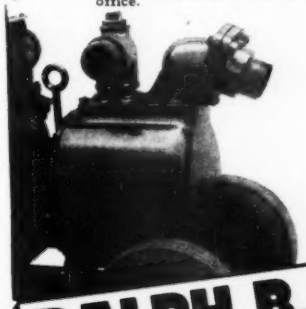

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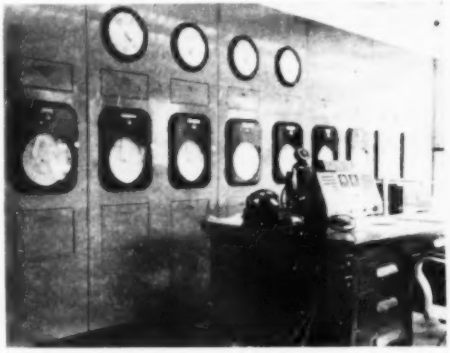
RADIO COMMUNICATIONS FOR PIPE-LINE SYSEMS

by W. T. Bulla

AS the great network of interstate oil, gas, and products pipe lines has been developed through the years, a prime requisite of the industry has been an adequate means of communication. In connection with pipe-line operation and maintenance, to insure efficient movement of the tremendous quantities of natural gas, oil, and oil products in the United States, all forms of communication presently available are used, being obtained from common-carrier communication companies who supply telephone, printer, and radio service. In addition, the pipe lines themselves operate many thousands of miles of wire facilities as well as a growing number of radio stations of their own. The use of radio can best be described by dividing it into two classes: communication for mobile operation, and communication for point-to-point service.

Mobile service.—Generally the mobile service constitutes a number of base stations located at strategic points on the pipe-line system together with a larger number of mobile radio stations installed in operating and maintenance automotive equipment. This provides two-way radio communication from operating headquarters and control points to field men located in company vehicles and from one vehicle to another. It is obvious that mobile service so arranged can render a real means of contact not available in any other way. In the handling of remedial work on pipe lines, whether it be an emergency or a planned job, prompt and reliable communication in coordinating personnel and equipment, and dispatching the proper men and materials in event of disaster, means the saving of many hours in restoring pipe-line service.

Base stations are comprised principally of towers, generally steel, from 100 to 300 ft. in height, on top of which is located the antenna, which is wired to the base of the tower where the main-station transmitter and receiver are located in a small building. A transmission circuit extends from this station building to the remote-control console usually located in the pipe-line operating office or station. Mobile units are made up of a small transmitter and receiver usually installed in the trunk of automobiles or in special protective housings for truck mounting and with a flexible antenna installed on the top or side of the vehicle. These transmitters and receivers are received from the manufacturer completely wired so that only a minimum of work is necessary to complete the installation.



Left, above: Remote control console of a two way radio in a New York pipe-line station. Right, above: Two-way FM base radio station in Pennsylvania. Radio station equipment in building at base of tower. The tower is 300 ft. high, with antenna on top

Two-way fixed radio in service in a remotely located Texas pipe-line station point

The Author

W. T. Bulla has been engaged in general communication work with oil and gas companies in the Midwest and Southwest area for the past 25 years. He is a member of the Mobile Radio Committee of the American Gas Association and vice chairman of the National Petroleum Radio Frequency Coordinating Association. He is presently employed with Natural Gas Pipeline Co. of America, Chicago, as superintendent of communication and dispatching.

There are also a number of small-pack portable units available which have a limited short range but which are very effective and are very useful in pipe-line operations. They do not involve the use of automotive vehicles and are reasonable in cost.

Equipment Developments

Equipment developments in the art have made rapid strides recently, so that many improvements can be secured in apparatus presently available, such as high-gain directional antennas, increased selectivity, improved frequency stability, less interference to similar stations operating on adjacent frequencies, and improved design to simplify maintenance. Most of these improvements have been gained at only slightly increased cost to the user. Mobile service is probably of far more importance to most users than any other type, so that in securing equipment for a given territory power and antenna gain should be limited to give satisfactory communication to that particular territory and thus create as little interference as possible to other users.

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The cost of equipment varies, depending on a number of factors. However, for estimating purposes, base stations will approximate 4 to 10 thousand dollars and mobile stations 4 to 7 hundred dollars each, installed and ready for serivce.

Point-to-point or fixed stations. — Installations for pipe lines operating in difficult or inaccessible terrain can be accomplished by using two-way microwave equipment. This is one of the manufacturer's very latest developments. Service of this type can be set up along a pipe-line route several hundred miles in length to provide a number of channels for voice transmission, teletype printers, telemetering, facsimile, and other forms of remote and control operations.

Supporting Towers

Depending on the topography involved, towers for the support of parabolic antennas or reflectors, spaced at variable distances along the pipe-line system, are necessary to permit a line-of-sight path clearance over or around all obstructions including trees and buildings. This path clearance must also take into consideration the curvature of the earth. The station equipment would be similar in appearance to present radio-communication equipment plus added carrier apparatus as presently used in providing several voice channels over a pair of telephone wires.

Most microwave systems will present problems unique to each particular system, therefore, engineering consideration must be made in each instance. However, manufacturers indicate such a system providing three or more voice channels plus a number of signaling circuits for teletype, telemetering, etc., at a cost less than $1,000 per mile.

Communication channels. — Radio transmissions are regulated by authority of the Federal Communications Commission which has issued, effective July 1, 1949, Part II—Rules Governing Industrial Radio Service, which covers petroleum, petroleum products (including natural gas) and pipe lines, and may be obtained from the Superintendent of Documents, U. S. Government Printing Office, Washington 25, D. C. (10 cents). The FCC has recognized the need for fixed point-to-point radio-station requirements of pipe-line and other services and have indicated a number of frequencies that may be available, above 960 megacycles, for such communications. Channels are also provided in a number of frequency bands below 960 megacycles for mobile service or as an auxiliary service to regular communication lines for point-to-point communication.

The present rules have been greatly relaxed by FCC as proper showing has been made by industry, and particularly as pipe-line companies have

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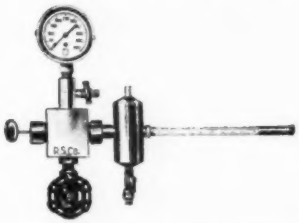

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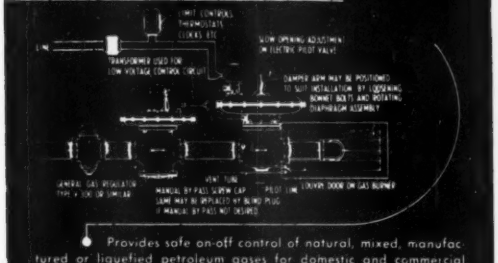

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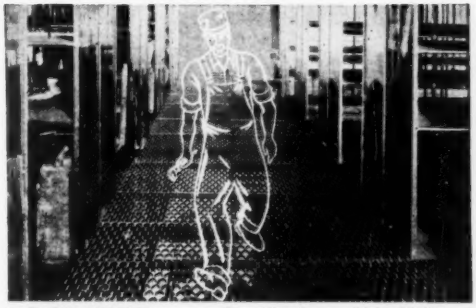

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demonstrated the importance that radio communications can play in providing for safety of life and protection of property.

Station operating requirements define permissible communications so that pipe lines have a reasonable degree of latitude. Communications of any licensee should be limited to matters related to safety of life or the protection of property; and those communications considered essential to the efficient conduct of the licensee's operations, keeping in mind that many frequencies are shared with other users, so that each licensee should see that harmful interference is not caused to other stations also licensed in this service.

Having in mind that an organization representing the petroleum radio service would be necessary, the National Petroleum Radio Frequency Coordinating Association was organized in Kansas City, Mo., on June 13, 1949. National officers elected included:

Chairman, H. A. Rhodes, Humble Pipe Line Co., Houston; vice chairman, W. T. Bulla, Natural Gas Pipeline Co., Chicago; secretary-treasurer, W. G. McLarry, Magnolia Pipe Line Co., Dallas; and the following members of the executive committee: O. B. Hocker, R. D. Wyckoff, W. A. Shipman, J. D. McCullough, L. C. Bomar, R. S. Caplan, W. T. Born, K. S. Hagius, and J. A. Polhemus.

The United States has been divided into seven regions, with an organization for handling applications for petroleum radio service in an advisory capacity, and to be helpful in assisting applicants for frequencies in this service in the selection of a frequency as nearly interference free as possible so that maximum efficiency may be utilized.

Applicants for Petroleum Radio Service may contact the following regional frequency coordinating chairmen representing the various states:

Region I—comprising the states of Maine, Vermont, New Hampshire, Massachusetts, Rhode Island, Delaware, New Jersey, New York, Pennsylvania, Maryland, West Virginia, and Virginia—W. A. Shipman, United Fuel Gas Co., P. O. Box 1273, Charleston, West Virginia.

Region II—comprising the states of Wisconsin, Michigan, Illinois, Indiana, Ohio, and Kentucky—J. D. McCullough, Buckeye Pipe Line Co., Lima, Ohio.

Region III—comprising the states of Tennessee, North Carolina, South Carolina, Alabama, Georgia, and Florida—L. C. Bomar, Southern Natural Gas Co., Birmingham, Alabama.

Region IV—comprising the states of Arkansas, Mississippi, Louisiana, and Texas—R. S. Caplan, Gulf Refining Co., pipe line division, Houston.

Region V—comprising the states of North Dakota, South Dakota, Minnesota, Iowa, Nebraska, Kansas, Missouri, and Oklahoma—F. J. McElhatton, Panhandle Eastern Pipe Line Co., Kansas City, Mo.

Region VI—comprising the states of Montana, Wyoming, Utah, Colorado, and New Mexico—Karl S. Hagius, Colorado Interstate Gas Co., Colorado Springs, Colo.

Region VII—comprising the states of Washington, Oregon, Idaho, Nevada, Arizona, and California—David Sheffort, Western Geophysical Co., Los Angeles.

Automatic

Submerged Arc Welding Increases Efficiency

by F. W. Zilm

WELDING in its various forms, now commonplace in the petroleum industry, railroads, marine equipment, manufacturing and industrial plants, and all kinds of construction projects, has advanced within the last three decades (from the oxy-acetylene putting-on tool of the village blacksmith) to a basic industry employing some 2 million workers of the nation. It is interesting to note that welding has completely revolutionized construction methods of pipe lines, oil refineries, gasoline plants, and other petroleum-processing equipment, and has greatly improved the operating efficiency of all phases of the petroleum industry, especially the repair and maintenance of pipe-line systems.

There have been five distinct types of homogeneous welds in general use by the pipe line and petroleum industry within the last 30 years, namely:

Oxyacetylene ripple weld—1920 to 1930. Metallic arc weld (bare rod)—1920 to 1931. Oxyacetylene backhand weld—1930 to 1933. Shielded arc weld—1931 to present. Automatic submerged arc weld—1940 to the present. (For fabricating pressure vessels,

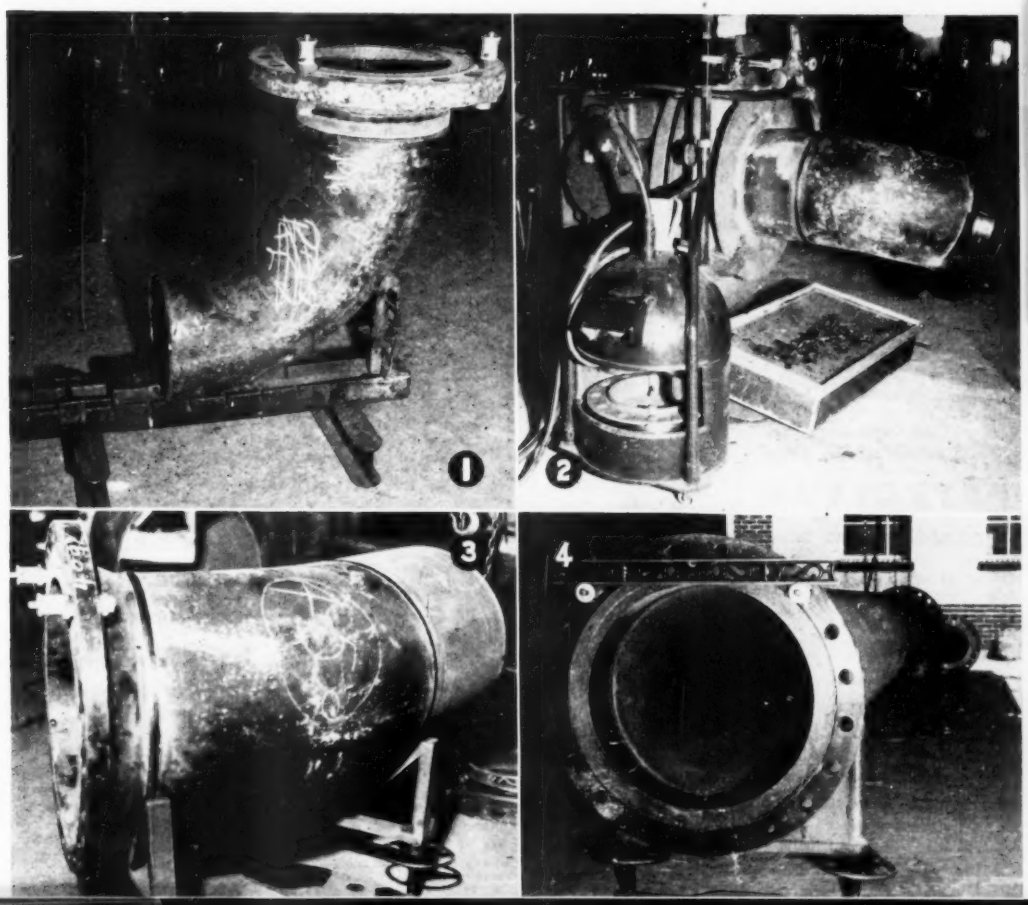
F. W. Zilm became associated with Stanolind Pipe Line Co. in 1933, being employed initially on a field crew in Illinois. His experience since that time has covered practically every phase of welding. In 1945 he was transferred to Tulsa, and in March 1948 was appointed welding technician. He has been connected with all the major construction projects of the company since that time. During the war he served as welding instructor in an ordnance school in Nebraska. More recently he organized and was head of the welding school which was sponsored by the Mid-Continent Pipe Line Chapter of the Associated General Contractors of America.

1—Lineup jig for placing flanges and fitting in correct alignment for tack welding

2—Part in welding positioner ready for automatic welding

3—Subassembly station for checking and assembling

4—Final station for checking alignment and straightening



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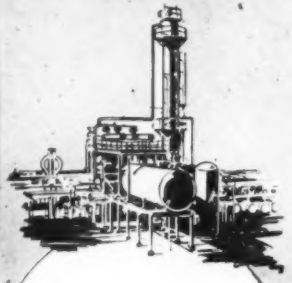

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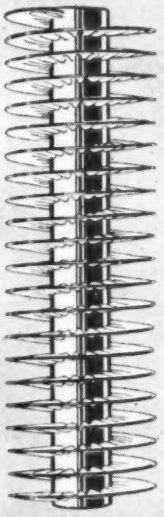

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5—Storage for fabricated parts

longitudinal seam welding of pipe, double-joint welding of large-diameter pipe, and is currently being developed for double-joint welding of pipe along the pipe-line right-of-way.

Heretofore automatic submerged arc welding has been used extensively in tank and vessel-fabricating plants; pipe-manufacturing plants; in the manufacture of heavy structural members, pipe fittings, such as ells and tees, and more recently has been adopted in pipe-fabricating shops where various types of fittings are assembled and welded into members of a piping system.

The automatic submerged arc weld is employed by several pipe-manufacturing plants for making longitudinal seam welds and girth welds on pipe. It is particularly adaptable for this application because welds of higher quality are produced, and its use effects substantial savings in manufacturing costs through greater production and fewer rejects of the finished products.

Although automatic welding has been confined, primarily, to shop applications, it has recently been adapted to field use by some pipe-line companies, both domestic and foreign, as this process has many advantages. With the trend to large-diameter pipe lines numerous other applications for this process are coming into use. This is emphasized by the fact that the shielded arc weld, (which was accepted throughout the pipe-line and petroleum industry for many years as the most efficient type of joint for both oil and gas pipe lines), is being supplanted wherever practical with the automatic submerged arc.

Considerable effort is being applied to developing and testing the submerged arc process for pipe girth welds, and it has been found that by the proper spacing of pipe ends, coordination of welding current, wire feed, and speed of rotation, a simple lightweight backup shoe may be used with good success. The quality of a weld by this method is far superior to a weld having a stringer or first bead applied manually, and succeeding beads applied by submerged arc. Obviously, the submerged arc process will greatly increase the progress and efficiency of laying large diameter pipe lines.

High-Pressure Piping Systems

The automatic submerged arc process, coupled with the proper arrangement of plant facilities, greatly increases efficiency in pipe-fabricating shops, especially where it is possible to use a straight line flow of parts and subassemblies through the various stages of fabrication.

A modern high-pressure piping system consists of forged-steel flanges, forged-steel ells and tees, and extra-heavy seamless pipe assembled by welding. The pipe being cut into nipples of suitable lengths, is aligned and tack welded to the flanges and fittings.

Special rotating equipment, lineup jigs, fixtures, and adequate tools, are very essential in the assembly and welding of fabricated piping systems, and result in better finished products at substantial savings in production costs.

Fig. 1 shows the lineup station where flanges and fittings are placed in the proper alignment before being tack welded. A welding ell and flange (which is a primary assembly) are held in position with a special jig preparatory to tack welding. This part then moves to the welding zone and is placed on a welding positioner and welded by the automatic process, shown in Fig. 2.

After being welded, the primary assembly moves on to the subassembly station where it is checked and assembled with other parts (as shown in Fig. 3). The adjustable lineup jacks facilitate leveling the assembly and insure greater accuracy in the finished part. The assembled manifold part then moves to another welding station for welding, either by the submerged arc process or hand welding. This depends largely on the shape or design of the assembly.

The completed part then moves to the final station, where it is checked for alignment and straightened to conform with the dimensions given on the drawing. (See Fig. 4.) The lineup pins supporting the level facilitate aligning the various parts into subassemblies and provide convenient means of checking the completed unit. Each component part is then tagged for shipment. Fig. 5 shows storage area for fabricated parts.

By conservative estimates it has been determined that one automatic welding unit has a production capacity in excess of two manual welding units, and the following summary may be used as a basis for estimating the cost of equipping a shop to use one semiautomatic welding head:

One 200-amp. welding machine for tack welding subassemblies.

One 600-amp. welding machine complete with semiautomatic welding head mounted on portable stand.

Two variable-speed positioners.

Miscellaneous items, including hand tools, flange lineup pins, and adjustable lineup jacks.

Approximate cost of equipment listed above, $3,835.

The welding equipment listed in the summary has been found particularly adaptable for pipe-fabrication work. It will be noted that the welding mechanism is mounted on floor casters, which make it readily movable from one welding positioner to another, and the welding head may be quickly adjusted to the work by having vertical, horizontal, and lateral movement through gear boxes and racks. This method of mounting effects a saving of possibly $1,000 as compared with a full automatic type of welding head mounted on a carriage suspended by an overhead beam.

The items of equipment listed above are well standardized, and available through industry trade channels. The cost of the automatic setup is approximately $800 more than the cost of equipping a shop for producing an equal amount of work by manual welding methods; however the additional cost is soon amortized by the savings in labor and increased production, based on the following:

1. Eliminates time loss in changing electrodes.

2. Minimizes time required for slag removal on intermediate and final passes.

3. Nonspattering metal deposit gives better appearance to weld.

4. Welding speeds of 20 to 30 in. per minute with automatic welding, as compared with 10 to 15 in. per minute by manual welding.

In conclusion, it may be pointed out that there are several factors which govern the successful application of the submerged arc welding process, in welding pipe and pipe fabrications. These include: the type welding head, size of filler wire, speed of wire feed, amount of welding heat, speed of power roll, diameter and wall thickness of the pipe and fitting. It has been found advisable for fabricating shops to select qualified welding personnel, and thoroughly train them as operators of automatic welding machines; the experienced welding operator is better qualified to observe the welding characteristics of the product, also to analyze and correct faults when trouble is encountered. Experience has shown that persons qualified to do shielded arc welding can learn to operate the submerged arc in a period of 2 to 3 weeks.

Improvements in

Diesel-Engine Overhaul Procedures

Developed for a crude-oil pipe-line system

by J. E. Chapman

NEARLY every detail of overhaul and replacement procedures for diesel engine has had possibilities for improvement as the result of analysis of the familiar routines and by the adoption of methods developed in modern industrial plants in recent years.

In spite of this, many heavy-duty-engine mechanics are still laboring with obsolete systems, such as were used 25 years ago, requiring 3 to 4 weeks to overhaul a pipe-line diesel engine.

While crude-oil pipe lines generally are not now pushed to operate continuously under overloaded conditions calling for minimum overhaul shutdowns, such as were experienced during the war, the procedures which make it possible to overhaul a 400-hp. engine in 72 hours down-time are valuable for attaining the economies coming from efficiency.

In this article the author undertakes to present the overhaul methods used by Pan American Pipe Line Co. for the eight 400-hp. diesel engines on its 200-mile Kilgore-Texas City trunk line consisting of 150 miles of 12-in. and 50 miles of 10-in.

The eight 400-hp., four-cycle engines at the four stations are 13-in. bore by 16-in. stroke with six cylinders.

Since the utilization of a mandrel for alignment of main bearings is the principal innovation developed for the company's diesel program it will be discussed first before beginning a description of diesel overhaul including improved practices for dismantling and cleaning.

By keeping an accurate record of every wearing piece in the engine, we anticipate when parts need to be repaired.

The effectiveness of the preventive-maintenance program is indicated by the fact that in the 12-month period, from August 1, 1948, through July 31, 1949, shutdowns due to mechanical failures have amounted to only 4½ minutes per month per engine. Engines went in service in the winter of 1940-41.

Construction of Mandrel

The mandrel was made primarily to reduce to a minimum the time for fitting a crankshaft to a set of new bearings. The mandrel made it possible to accomplish within 6 hours what often took several days in the ordinary way, due to the fact that the heavy 6,000-lb. crankshaft has to be handled very carefully to prevent stringing it out of alignment. The mandrel has also proved to be valuable in checking the alignment of the old main bearings during routine overhaul operations.

James E. Chapman, mechanical superintendent, Pan American Pipe Line Co., started with the company in July 1941 as division mechanic, a few months after the East Texas-Texas City crude-oil trunk line was put in operation. He became master mechanic in October 1945, and mechanical superintendent in January 1947. For 26 years Chapman has been engaged in the operation and maintenance of heavy stationary diesels. In 1923 he started with diesels of Lone Star Cement Co. He was master mechanic and chief engineer for Perkins Sand & Gravel Co. in 1928-29. In December 1929 he became division mechanic for Texas Louisiana Power Co., now Community Public Service Co.

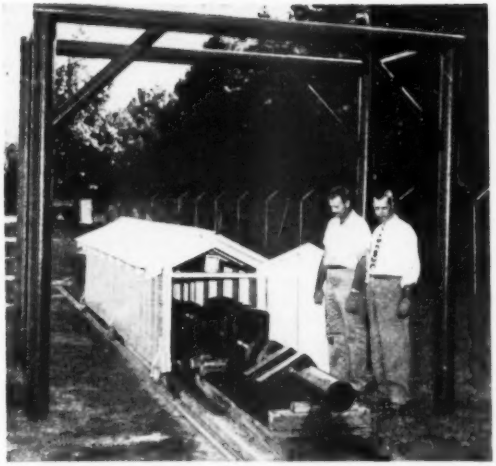
Hayne Nelms, station chief engineer, and the author, J. E. Chapman, standing between tool boards at Pan American Pipe Line Co.'s Douglas, Tex., station. Tools are arranged in a uniform manner prescribed for all main-line stations of the company

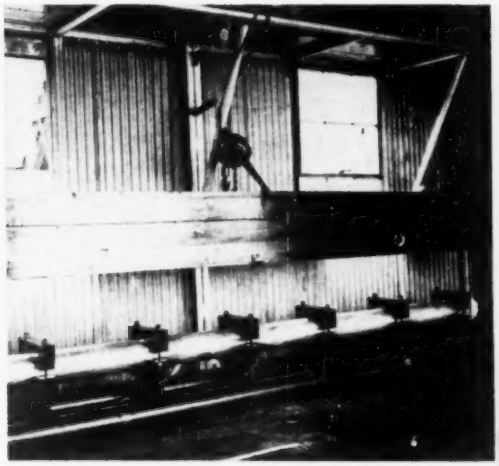
Mechanical steel tubing, of 1-in. wall thickness, with a ground finish has been utilized for this mandrel which is stored at one of the stations from which it may be conveniently moved to other stations where needed. It was necessary to have the mandrel hollow so that it could be filled with water to prevent warping while machine work was done.

Mandrel is finished with a diameter of 7.5015-in. or 7½-in.+.0015 in. and is 16 ft. long. Two holes at each end of the mandrel provide for inserting a bar to facilitate turning while placed in the engine bearings.

Measures taken to prevent springing the mandrel when it is transported from one station to another were discovered to be vitally important for maintaining its accuracy. Without the protection furnished by a spring-loaded carrier skid, the mandrel readily got out of alignment by ordinary methods of handling.

When packed in the spring-loaded carrier the mandrel is fitted in eight wooden block cradles machined to size. These blocks are mounted on springs attached to two 6-in. pipe skids. There are two upper and lower springs for each wooden cradle. Cradles are held in position by long bolts. Rough handling, when the mandrel is packed in these spring-loaded





Left: A spare crankshaft is stored in the Douglas station yard under a special shelter which may be readily slid on tracks. Loading and unloading are facilitated by permanent steel frames available for hoists. Right: Mandrel packed in spring-loaded carrier to protect against rough handling. Wooden box normally covering mandrel while in storage was raised by counterbalance device just before the photograph was taken

cradles, does not spring the mandrel. This method of packing has been tested by dropping the mandrel, with such spring carrier packing, from a truck.

Normal wear requires checking of main bearing in service every 2 years. After main bearings have been in service for several months, they will wear down to a point where they do not have enough side clearance. After the engine has been stopped and cooled down, the bearings are so close that they grip the crankshaft. To avoid such occurrences, the mandrel has been made with a diameter .0015-in. larger than the crankshaft measurements. This gives sufficient clearance for old bearings.

Lining up old bearings with the mandrel for refitting normally takes 3 hours.

In checking alignment of bearing cradles, the mandrel method has advantages over the established practice of aligning with 14-gage piano wire to determine whether any bearings are low due to warping of the engine bed or excessive wear at certain places. Such wire checking has customarily been only applied when instruments indicate that the crankshaft is low at the end or the middle. For this type of checking, the mandrel method avoids errors due to sag in the wire. "Shadowing" by a flashlight around the mandrel shows which, if any, bearing cradle is low.

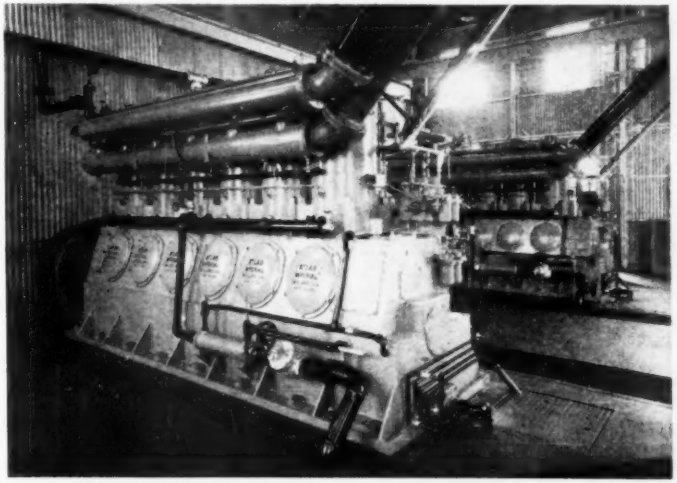
If a crankshaft is found to deviate more than .004 in. from correct alignment when it is checked during overhaul, realignment is done with the mandrel.

A double check of the crankshaft with strain gage directly below the crank pin shows whether the crankshaft is actually on the bearing or whether it is floating. Such an indicated deflection would lead to crankshaft breakage.

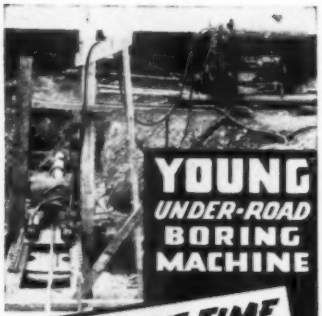
Compressed air at 250 psi. is applied in the cylinder in testing for deflection. Simultaneously, piston rings, valves, etc., are thus checked for leakage. The compressed-air method appears to be preferable to the use of hydraulic jacks and bridge gages which has frequently given incorrect readings. When alignment has been completed with mandrel method there is assurance that adjustments have been accurately made.

Both the mandrel and a spare crankshaft are stored at a centrally located pump station. The mandrel, packed in its spring-loaded carrier, is stored in a wooden box readily lifted by a counterbalance device. The spare crankshaft is in a low weatherproof shelter of corrugated-iron and wood-frame construction, mounted on wheels running on a track, so that it may be easily moved away.

For removing the mandrel from its carrier and for moving in the station itself, it is handled only with soft lines. Care is taken that it is not picked up in the middle, that it is suspended at two points and that it is level at all times.



Typical main-line station on Pan American Pipe Line Co.'s main-line system with two 400-hp., 4-cycle diesel engines which drive centrifugal pumps



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New procedures in diesel engine overhaul which depart from standard pipe-line practice not only assure better mechanical conditions for the engines, but they are economical in terms of manpower and overhaul expense. These procedures will be outlined in the following description.

All parts are cleaned by hot cleaning fluid when the engine is dismantled. Wherever possible, such cleaning is done in a vat equipped with a davit and chain hoist, placed just outside the engine-room door to which parts may be carried by the overhead crane. Larger parts are cleaned in place by spray.

The standard method of cleaning with scrapers and wire brushes is not only slow, but it is injurious because of the inevitable scratching and burring of parts. Furthermore, reduction in the use of wire brushes operated by electric motors lessens the fire hazard. Altogether, the cleaning fluid method makes it possible to avoid the dirty conditions found where standard methods are used. Floors are clean at all times. Five fewer men are needed for cleaning parts with the use of the cleaning fluid method.

In preparing for an overhaul, the floor is covered with brown building paper, on which 1 by 2-in. boards are placed which are covered with another layer of brown building paper.

Immediately after the part is cleaned, it is sprayed with lubricating oil and placed on the floor at a position specified. Just before reassembling, the lube oil and dust are cleaned off with Varsol and then the parts are finally oiled by hand as they are replaced in the engine, by accepted practice.

Instead of scattering parts on the floor according to the familiar overhaul custom, parts are removed in a definite predetermined order; they are laid out on the floor in specified positions designated in overhaul orders which are compiled so that they may be strictly and uniformly followed in the overhauling of engines at all the company stations.

Every man engaged in overhauling is as carefully trained for following the specified sequence of operations as in any other part of the work. In some cases the order of dismantling and assembling is changed to expedite the job to meet certain conditions.

The overhaul mechanics are notified several days in advance to be ready for a certain engine that is coming down for overhaul on a specified day. Last-minute instructions are usually given to the mechanics just before the work is started; each man knows exactly how the equipment is going to be dismantled, cleaned, inspected, and assembled. Every job follows this identical plan. The division mechanic is in charge and watches every phase of the work. He never permits the work to drag. Neither does he let the men race their jobs. If any of the men run into difficulties in a job, the division mechanic immediately gets the situation straightened out. The division mechanic does all inspecting and logging of the working parts and sees that the equipment is properly dismantled and assembled. The men doing the work are all trained to help each other so that they may carry on the job together to best advantage. Results of such teamwork pays off.

Overhauling is facilitated by electric and pneumatic tools for handling, dismantling, and assembling. Special tools have been shop-made to work in hard positions. Slings, eye bolts, hooks, and special lengths of chain have been made for quick rigging. Speed wrenches are used for practically every bolt and nut.

An electric hoist with a load chain speed of 16 ft. per minute not only hastens the work, but it avoids the damage done to engine parts by the swinging of chains of hand-operated hoists.

In advance of overhaul we determine from information in our records what machine shop work will be required. A definite time schedule is arranged with shop foremen so that they will know exactly when parts will be received and when they will be picked up by trucks for delivery to the pump station.

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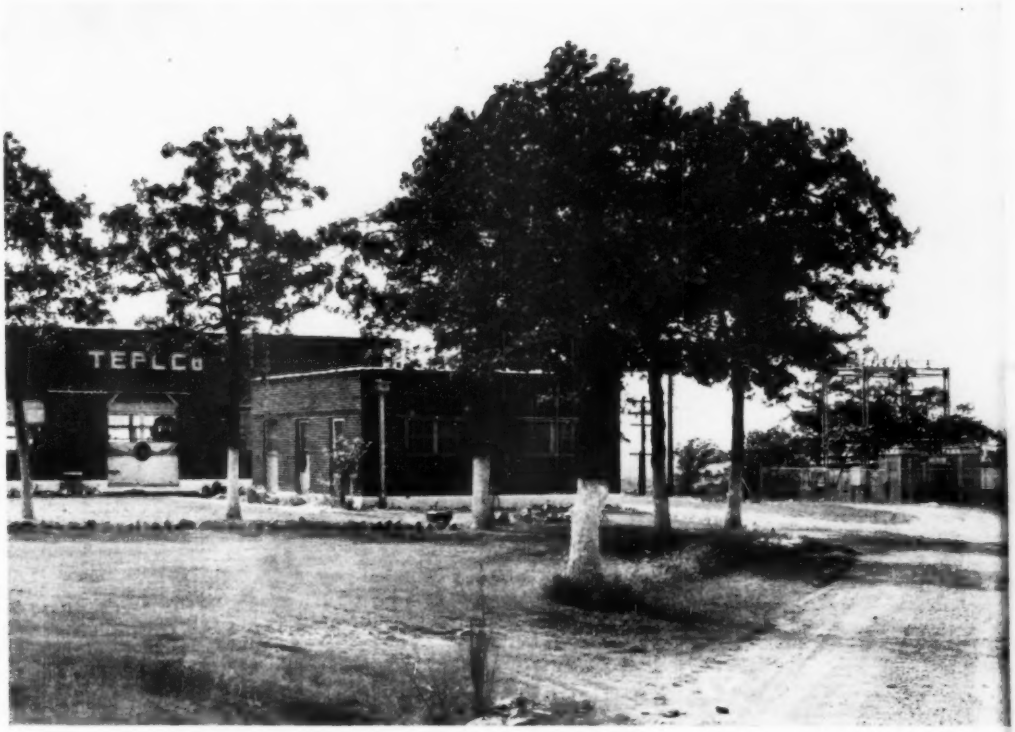

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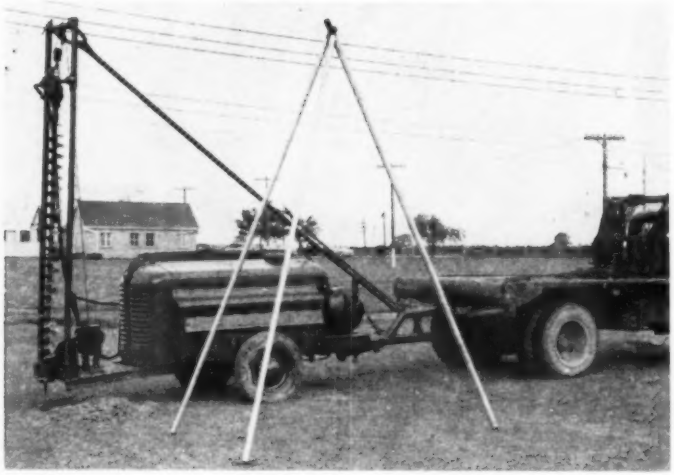


Earth auger in position for starting hole. Tripod in foreground is for use when auger is not trailer mounted. Guy rod from top of auger mast to trailer hitch is used as torque arm when auger is suspended from tripod

Air-Driven Earth Auger

Provides flexibility and economy for cathodic-protection installations

by Dean C. Glass

THE conventional, power-driven earth auger has a long and varied list of services and accomplishments. Another adaptation, proved by actual field experience extending over a period of almost 2 years, has been developed by Pure Transportation Co. Through a series of tests in Michigan, West Virginia, and Illinois, the air-driven earth auger has proved to be an effective, flexible, and economical instrument for drilling holes for installation of magnesium anodes for cathodic protection of pipe lines.

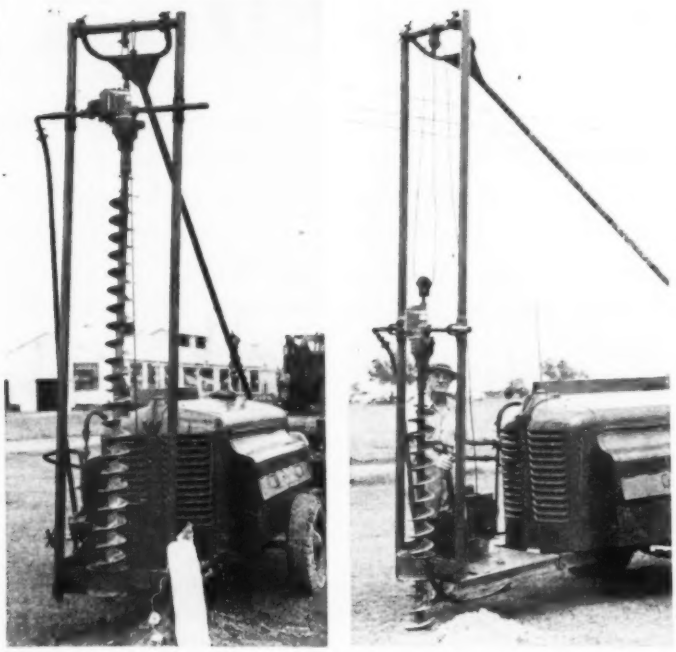
Basically, cathodic protection of pipe lines is a form of preventive maintenance. Since the majority of pipe lines considered for cathodic protection were bare, the maintenance programs being dealt with were dependent upon two familiar factors; the size of investment which had to be maintained, and maintenance costs.

Generally speaking, the amount of maintenance work to be performed on pipe-line systems is very irregular and cathodic-protection work is used largely as slack-time work to fill in when crews are not performing other duties. Fitting cathodic protection into such an operating procedure requires maximum utilization of manpower and equipment since the equipment costs have a direct bearing on operation, labor, and maintenance expense.

Prior to development of the air-driven earth auger, magnesium-anode installations were made in hand-augered holes. These holes were 8 in. in diameter by 6 to 8 ft. deep and were made at intervals of 30 ft. along the pipe-line right-of-way. In what might be termed ordinary soils, a crew of 16 men was required for hand-augering 45 to 50 holes per day and installing the same number of anodes.

The common or post-hole type-hand auger was used, and in starting a hole it was necessary to break the earth's crust or sod with pick and shovel. In formations too hard for hand augers to operate efficiently, crowbars would be used to loosen the soil for removal by the auger. To bore to a depth of 6 to 8 ft. required extensions to the main auger shaft and, as a result of this time-consuming procedure, a search was made for equipment to speed up the job.

Trailer-mounted air compressors were available at each pipe-line division where anode installations were being made. Since it has long been recognized that compressed air is particularly valuable where power is required intermittently and at a distance from its source, it seemed



Photograph at extreme left shows closeup end view of auger unit in drilling position with anode leaning against frame. The other picture shows the auger at 5-ft. depth, with the operator at air controls

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The Author

D. C. Glass, engineer for the transportation division of Pure Oil Co., devotes his time to corrosion and maintenance problems of the various company facilities. A graduate of the department of chemical engineering of Ohio State University, he was initiated into the oil industry by the Texas Co. at Marrero, La., before joining Pure. He was employed by Pure in 1936 at the Toledo refinery and in 1937 was transferred to the pipe line division in Illinois as field engineer. In 1938 he began working on corrosion problems of Pure's pipe-line divisions. In 1942, as a reserve officer, he reported to active duty in the Air Corps and returned to Pure in 1946 in his present capacity.

logical to utilize air as a source of power for driving the earth auger. Utilization of compressed air for power required the investment of approximately $700 for additional equipment, compared with an investment of several thousand dollars in the conventional power-driven equipment that would be utilized only a few weeks out of the year.

Other factors in favor of the air-driven auger were flexibility in utilizing the air compressor for driving pavement breakers, small portable tools, power pumps, and other equipment.

Cathodic Protection Use

In addition to the foregoing advantages the air-driven auger could be used for cathodic-protection installations in explosive areas, since, by means of a long air hose and the lightweight tripod, the auger unit could be operated inside tank dikes, in refinery areas, etc., and the gasoline engine and air compressor kept outside the explosive zones. In limited working places, too, the tripod-mounted unit could be used and anodes installed where it was not practical to use a truck, trailer, or conventional power-driven auger.

To meet our requirements, the open-blade type auger was selected because it could be loaded, withdrawn from the hole, and dumped by a quick whirl of the reversible air motor, thus throwing the material away from the auger by centrifugal force. This procedure also expedited removal of stuck augers from the hole. For raising and lowering the auger, a second air motor was provided. This motor was mounted on the shop-made trailer platform and drives

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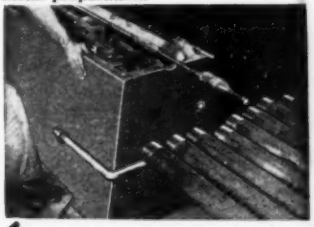

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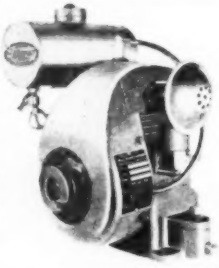

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a hoisting drum and cable which controls the weight and rate of feed applied to the auger. This weight and rate of feed must be adjusted for penetrating earth formations at the highest rate consistent with protection of the cutting edge of the auger, drilling a straight hole, and fatigue limits of the auger.

To modify the existing gasoline-engine-driven, trailer-mounted air compressor for accommodating the earth auger, it was necessary to add a hinged platform to the trailer frame. This hinged platform permits the equipment to negotiate rough terrain and provides for quick dismantling of equipment when necessary for tripod mounting.

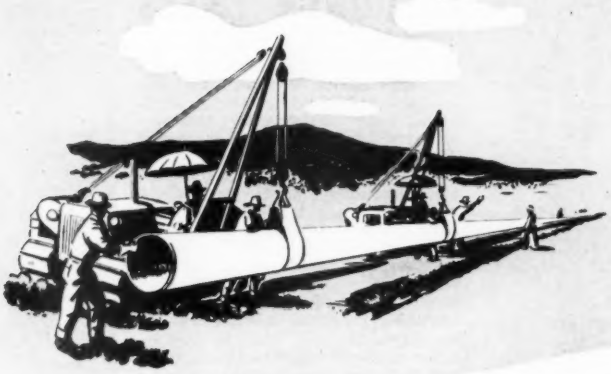
Equipment Installation

To the hinged platform was added a tubular mast, hoisting equipment, controls, all conveniently located within reach of one operator. Accessory equipment varies according to diameter of holes desired and purpose for which they are drilled. By varying height of the tubular mast and adding sections to the auger, it is possible to bore holes to any desired depth consistent with equipment and soil conditions. The complete air-driven auger, as equipped for boring 8-in.-diameter holes to a depth of 8 ft., is portable and can be towed by a truck, as shown in accompanying photographs, or by tractor and can be mounted on skids, mud boat, or truck bed.

Normal operations of the equipment when truck-towed requires a three-man crew, and success in fast drilling depends particularly upon the efficiency of the crew and upon soil structures. For comparison with old method of hand augering holes in rock-free soil, a hole 8 in. in diameter by 8 ft. can be augered in approximately 2½ minutes.

In utilizing the air-driven auger for magnesium-anode installations at intervals of 30 ft. along the pipe-line right-of-way, the usual procedure is to carry anodes on the tow-truck bed and have them installed by the auger crew upon completion of the holes. As the result of this procedure, the speed with which holes are augered is determined by the rate at which anodes are installed in the holes. In addition to the drilling crew, three men are normally used for digging bell holes and electrically connecting anodes to the pipe line. With a six-man crew and the air-driven auger, a normal day's work will permit installation of from 80 to 100 magnesium anodes.

From the economy standpoint, Pure Transportation Co.'s experience with the air-driven auger indicates that it was possible to double the number of anodes installed per day and decrease the number of man hours required for the installation by more than 50 per cent.



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New Type Lubricant Cuts Plug-Valve Maintenance Costs

MILLIONS of plug valves are used in numerous installations concerned with the production, processing, and transportation of petroleum and natural gas. The many users of pressurized plug valves are expected to obtain considerable savings in maintenance and servicing costs through the application of a system of valve lubrication which uses a new type of compressible plastic lubricant. Advantages claimed for the superior "Hypermatic" lubricant are automatic lubrication of the valve after injection, less frequent addition of fresh lubricant to the valve, and maintenance of the valve in operable condition for emergency operation with a minimum of prior relubrication.

The Hypermatic lubricant may be applied to old plug valves without making any change in the valve itself and without purchase of any special equipment. It is applied in the same way as any other lubricant by insertion in stick form or by a high-pressure grease gun. Basically, Hypermatic is similar to standard materials in lubricating properties and wetting action but is compressible, featuring greater elasticity which permits it to flow easily into voids, and maintain an unbroken film surface when applied to valves designed with lubricant grooves. A number of pressurized plug designs, illustrating various arrangements of lubricant channels, are shown in Fig. 1.

The lubricant functions under pressure in these grooves, which connect with grooves in the valve body to form a circuit around the ports, sealing the seating surfaces automatically. When any void has been filled or when valve turning has been completed the lubricant comes to rest, assuming again its plastic form with all lubricated surfaces perfectly sealed. The lubricant is held under pressure between the sealing surfaces and the ball check valve in the stem. In Fig. 2 one of the plug grooves was scraped clean of lubricant to simulate an exaggerated leak. The end plate with hose was bolted to the valve on the downstream side, the valve closed, 2,000 lb. pressure applied to the line, and the cock on the bleed line opened. Bubbles in the beaker indicated leakage for a

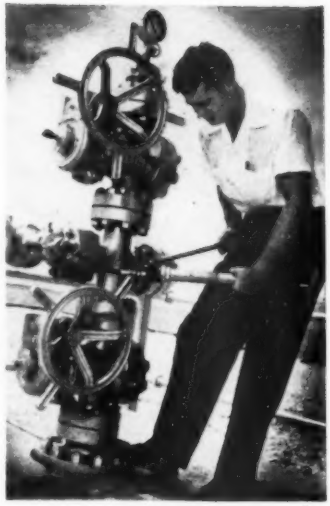


Fig. 4—High-pressure christmas tree in Texas being lubricated with Hypermatic by operator, using high-pressure booster-type grease gun

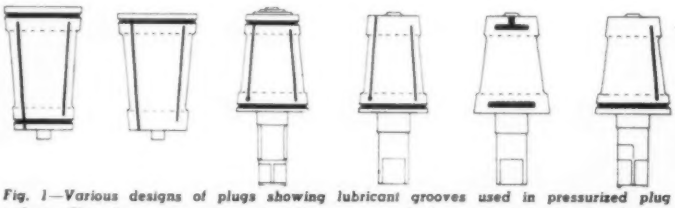
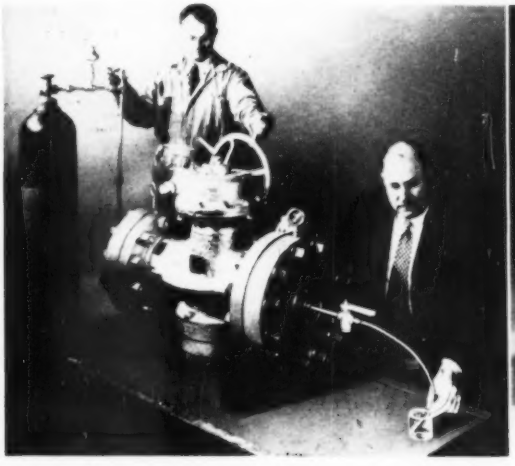


Fig. 1—Various designs of plugs showing lubricant grooves used in pressurized plug valves. The plug grooves connect with grooves in body to form circuit around ports



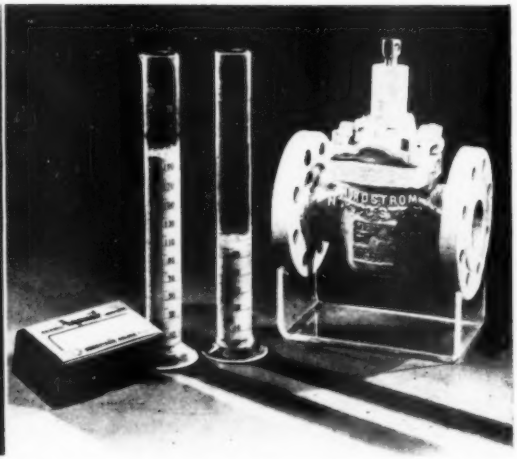


Fig. 2—(Left) Demonstrating action of Hypermatic in a plug valve. Shown making test are B. A. Perkins, assistant research engineer, and G. F. Scherer, chief of research, Nordstrom Valve Division laboratory, Oakland. Fig. 3—(Right) Comparison of amounts of lubricants storable in a plug valve. The beaker next to box shows volume of Hypermatic storable; beaker next to valve shows volume of compressible, nonautomatic lubricant storable

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few seconds, then ceased, showing almost instant action by Hypermatic in flowing into the scavenged groove of the plug automatically to seal the valve.

A greater amount of Hypermatic lubricant can be stored in the lubricant reservoir as compared to standard lubricant (Fig. 3). Sticks may be added beyond the volumetric capacity of the reservoir raising the pressure until the plug is jacked from its seat. Sufficient Hypermatic is injected to bring the lubricant reservoir pressure up to a point approximately 50 per cent above the rated working pressure of the valve. When this pressure falls below about 100 psi. the valve requires relubrication. On very high-pressure services it is advisable to keep the lubricant pressure above 200 psi. On very low-pressure service the lower limit may be set at 50 psi. It is claimed that addition of fresh lubricant is reduced to one-tenth or less the frequency required with standard lubricant. Greater flexibility is obtained in servicing. The operator does not have to keep a close eye on the valve and it is not necessary to relubricate at as frequent and definite time intervals. With Hypermatic lubrication valve life expectancy may also be extended, reflecting additional savings.

The Hypermatic plastic lubricant was developed by Nordstrom Valve Division, Rockwell Manufacturing Co., and has been made available in various types and grades suitable for different services in the petroleum and gas industries, handling hydrocarbon gases and liquids up to 250° F., as well as water, drilling mud, and nonreactive aqueous solutions in chemical processes. With further field testing of additional grades of lubricant other applications are anticipated at higher temperatures.

Scheduling and Dispatching

(Continued from page 181)

progress at the terminals nearest to the source point, and an effort must be made to secure long stripping deliveries at terminals upstream from the tail end of fuel cycles in order that the input rate of the system may be held to gasoline pumping rates for as large as possible percentage of the time.

As an illustration of the importance of this procedure, let us consider the passage of fuels through the Plantation 12-in. line. When heavy fuels enter the system at Baton Rouge, the entire 12-in. line would necessarily move at the reduced rate at which it is possible to pump fuels for the length of the fuel cycle plus the traverse time of the tail end of the cycle through the line if there were no stripping deliveries behind the cycle.

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the fuel cycle is: a kerosine buffer batch, diesel fuels and heating oils followed by kerosines and tractor fuels. The slowest moving product is the diesel fuel-heating oil. When the tail end of the heaviest or slowest-moving product has reached a point at which a stripping delivery of the lighter product (in this case, kerosine) is possible, the difference between the pumping rates of the two grades may be stripped off, and since the rate of the heavier product is no longer the controlling factor, the input rate of the system may be stepped up to the pumping rate of the lighter product.

As an example, Meridian station terminal lies 143,000 bbl. downstream from Baton Rouge, and Helena station (including an intermediate tank farm for the accumulation of products which will be pumped to laterals) lies 243,000 bbl. downstream from Baton Rouge. Bremen station, at the terminus of the 12-in. line, lies an additional 78,000 bbl. downstream from Helena. Diesel fuels move at approximately 3,500 bbl. per hour, kerosines at approximately 3,750 bbl. per hour, and gasoline at approximately 4,150 bbl. per hour.

The 12-in. line must move at the diesel fuel rate of 3,500 bbl. per hour until the tail end of the diesel (which is also the head end of the kerosine) arrives at Meridian. Assuming that there is to be a kerosine delivery at that point, a compensating stripping delivery may be started, and the input rate at Baton Rouge increased to the kerosine pumping rate of 3,750 bbl. per hour. When gasoline arrives at Meridian, a stripping delivery on that product may be started and the input rate increased to the gasoline pumping rate of 4,150 bbl. per hour.

During the progress of the stripping deliveries at Meridian, the tail ends of the diesel fuel and kerosine quantities have usually successively passed Helena station so that stripping deliveries may be maintained at that point until the heavy fuels have traversed the remaining 78,000 bbl. from Helena to Bremen and passed from the 12-in. line.

The arrival times of all 12-in.-line batches must be calculated for Bremen station since that point is the source point for the 10-in. main line and this information is basic for the compilation of 10-in. delivery and pumping schedules as well as those for two laterals. As a general rule, stripping deliveries are the most economical and efficient type of delivery operation, but, since the marketing areas of all shippers do not extend to the terminus point of the system, it is necessary that full-line stream deliveries be made for the products of some shippers at the last terminal point in their marketing areas.

In some cases, the quantity which is desired to be delivered from a batch is so large that it could not be delivered at an economical stripping rate during the period in which the batch is passing the point unless the speed of the entire system was reduced, and such deliveries are also made full-line stream. Deliveries must be made at stripping rates which afford the most efficient use of the pumping units, i.e., rates which will allow the use of a minimum number of pumping units to achieve the desired results. The optimum delivery rate allows the satisfactory delivery of the required quantity of product while allowing sufficient of the stream to pass the point to fully load all downstream pumping units. In our opinion, this item should be a major consideration in the placing of stations and delivery points, with particular emphasis on the latter, in the initial design and engineering of any products pipe-line system.

Fortunately, the units at the pumping stations on the Plantation system are connected in series, so that all of the horsepower at a pumping station may be utilized on a given unit setup. Inefficient use of the available horsepower at electrically driven pumping stations is probably the biggest factor influencing profit or loss on systems so powered.

Economies Effected

Since the major proportion of deliveries on the Plantation system are made to terminals on the 10-in. line, it has been determined that a continuous stripping delivery, or series of deliveries, could be maintained at Spartanburg (approximately midpoint on the 10-in. line) or at some point upstream from Spartanburg, so that it is possible to operate with two stations on the upper part of the system entirely out of service and one unit at a third station completely out of service. A considerable saving in both power and labor costs is effected through this adjustment, but the scheduling problem on this line is, of course, considerably magnified by the necessity for so arranging batches that continuous delivery may be afforded at the proper points and flow rates in the sections containing the inoperative stations may be held to the capacities of the remaining stations in that section.

A rather complicated system of interrupted deliveries has been worked out to allow full advantage to be taken of this possibility. In order to avoid introducing a great deal of confusion into this article, no attempt will be made to cover the calculation of interrupted deliveries to any extent since any such description would necessarily be both complicated and lengthy. Entry of products into the 10-in. line through the tiein to the Southeastern Pipe Line at Doraville must be so scheduled as to take full advantage of all periods when the 10-in. line would normally be operating at a reduced speed for the purpose of adjusting its rate to that of the 12-in. so that the commingled plugs on the head and tail ends of the fuel cycles may be taken directly through Bremen station from the 12-in. into the 10-in. without entering tankage at that point.

In summary, the 12-in. line is scheduled by a system of additive calculations in which the major factors are: the necessary time consumed by the traverse of the fuel cycles at slower pumping rates, the necessity for keeping sufficient product flowing into tankage at Bremen to feed the 10-in. line as nearly continuously as possible without filling tankage to such an extent that a slowdown of the 12-in. facilities would be necessary, the placing of batches in such a fashion that commingling which would result in degradation is held to a minimum, the placing of batches in such a fashion that stripping deliveries may be afforded as nearly continuously as possible at those terminals which are nearest to the source point in order that increases in throughput may be gained, and the necessity for making deliveries at such rates that the maximum use of the horsepower available is secured without waste due to throttling of units. The line must also be so scheduled that sufficient product is drawn off into tankage at the intermediate tank farm to meet pumping requirements for the four lateral lines at the proper times.

The 10-in. line is similarly scheduled by a system of additive calculations in which the major factors (in addition to most of those set forth for the 12-in. are: the necessity for maintaining a line operating speed so determined that the tankage at Bremen is never allowed to become too full to receive incoming batches from the 12-in. line, nor so nearly empty that it is necessary to shut down the 10-in. to await the arrival of batches which are in traverse in the 12-in., the arranging of batches so that a continuous stripping delivery is in progress at Spartanburg station or some point upstream from Spartanburg, the scheduling of batches entering the line at the Doraville tiein in such a fashion that the needs of the shippers utilizing the tiein are met at the proper time at their terminals, yet so that advantage can be taken of periods when the 10-in. would normally have to reduce pumping speed or shut down in order to adjust to the arrival time of batches from the 12-in. line.

It is usually necessary to make deliveries at several different stripping rates in order to accomplish these ends, and it is frequently necessary to close off at various times during a delivery, make a delivery at some other point, and open again to complete the interrupted delivery before the batch has passed the delivery point. At almost all times, deliveries are in progress at several terminals at the same time, and the differences in the speed of approach of the tail

end of a batch from which a delivery is being made (due to the completion of other deliveries at upstream terminals) complicate these calculations. Delivery schedules for all lines are accurate to a matter of minutes for periods of as much as 2 weeks in advance.

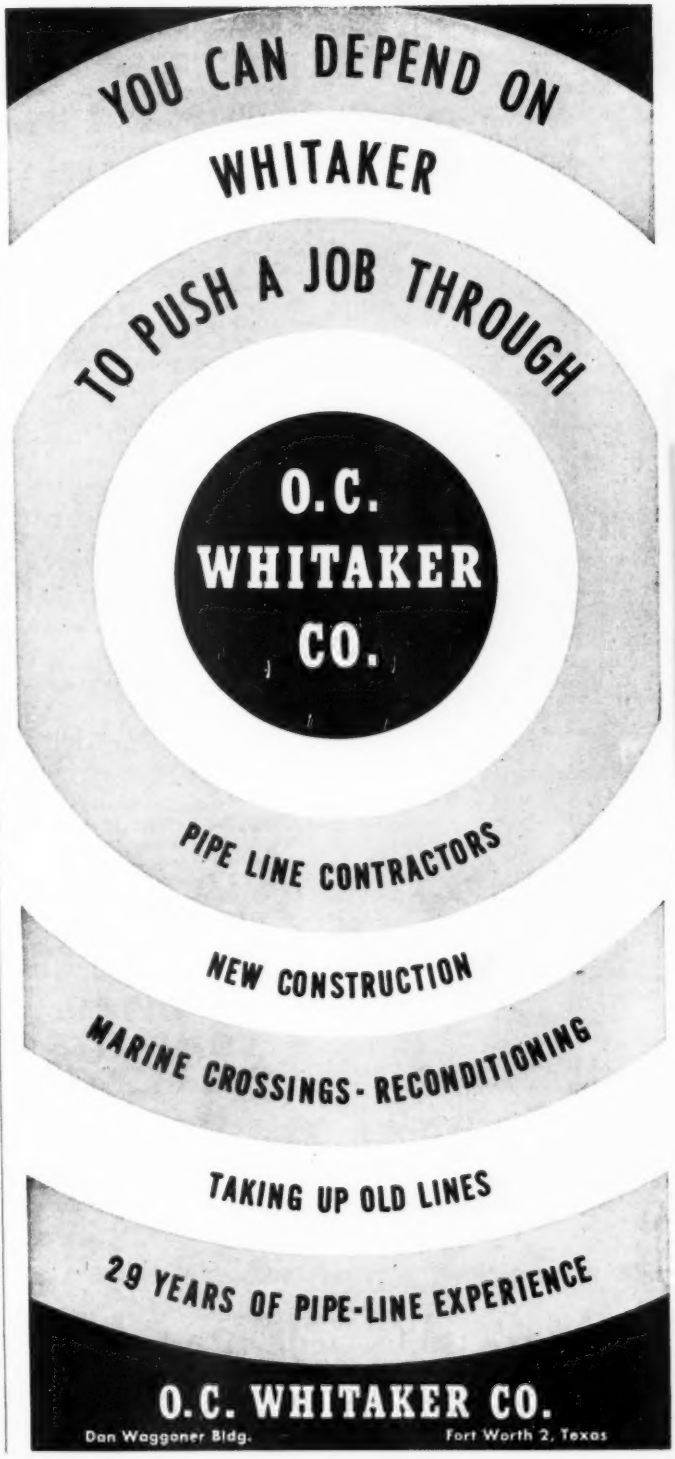
Although all lines must be very carefully coordinated, the volume of work precludes the possibility of both of the main lines being scheduled by the same individual. The 12-in. main line, the Birmingham and Montgomery laterals, and the Macon and Columbus lateral are scheduled by one employe, and the 10-in. main line and the Tennessee lateral are scheduled by another employe. These men must coordinate their work to a maximum degree.

When the daily delivery schedules have been compiled, each scheduler writes a pumping order covering the operation of the lines under his supervision for a 24-hour period. The pumping order is a skeletonized recapitulation of projected operations for the period which it covers. It furnishes the dispatcher with information as to products by batches to be pumped into the pipe line, tanks from which products are to be pumped or into which they will be received at intermediate tank farms, quantities of products to be pumped into or delivered from the system, sequence, and rate of deliveries, suggested unit setups for maximum operating and delivering efficiency, dye plugs which must be inserted, scrapers which must be run, methods of handling certain batches of products, and other pertinent information. The pumping order forms the foundation for all the work of the dispatcher and is the tying link between the scheduling and dispatching functions.

The Dispatching Function

In approaching the problem of devising satisfactory means for the performance of the dispatching function, it is readily seen that any mathematical or accumulative total system would not provide the necessary means for the following of batch movement because of the number of batches handled. It is usual to have 30 or more batches in the main-line system alone at all times, and without some visual means of following the progress of a batch as it moved through the pipe line, its location would be hopelessly lost.

The dispatcher must be afforded some method of instantly and accurately determining the location of any batch, dye plug, scraper, etc., in the system at any time and of calculating its arrival time at any point in the system to fine tolerance with a minimum of effort and expenditure of time. To accomplish this purpose, a large table called a dispatching board was designed and constructed. (See Figs. 2 and 3). The upper surface of the board is fitted with a



series of movable markers representing the pumping stations and delivery terminals along each line of the system. The markers are joined by sections of tubing and they were originally spaced at the correct distances in barrels for each section at 60° F. mean temperature and 475 lb. mean pressure at a scale of 2,000 bbl. per inch.

Vernier attachments are located on the sides of each marker to permit each section to be calibrated to the exact distance in barrels for the actual prevailing mean temperature and pressure in the pipe-line section itself. This is accomplished by lengthening or shortening the distance between any two markers through the use of the scaled verniers. The entire series of joined markers for each of the six pipe lines in the system moves in a trough recessed into the face of the board beneath removable covers of clear plastic. Friction in the marker mechanism is almost negligible since the entire apparatus rides in a ball-bearing race. (See Fig. 4). Directly in front of the markers, the line fill by batches is depicted by a series of colored tapes. Each batch is represented by a tape which is joined to the batch tapes ahead and behind it by means of scotch tape fitted to the underside. The lower edges of the tapes are printed with two bands of color. The outer of the two color bands indicates the company owning the product, and the inner of the color bands indicates the type of product making up the batch. For instance, a batch of tractor fuel, which has an identifying color of green, belonging to "X" company, which has been assigned an identifying color of red, would be represented on the dispatching board by a tape banded on the lower edge with an outer color band of red and an inner color band of green. The color bands are ¼ in. in width and are easily distinguished from some distance. The upper edge of the tapes is scaled to 2,000 bbl. per inch.

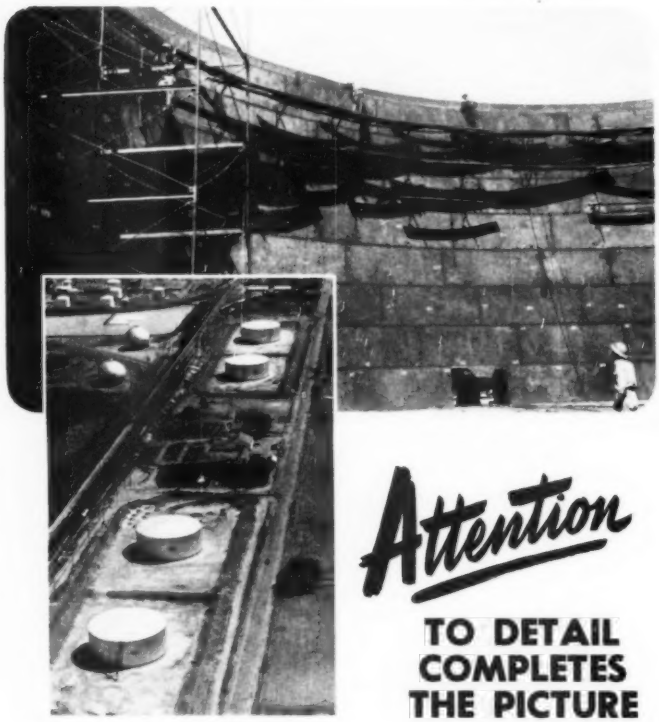
When the pumping of a batch of product into the line at a source point is completed, the tape is cut at the correct scaled barrels, and a new tape, correctly banded for the product to which the switch is made, is attached to the completed tape. (See Fig. 5.) Each hour, as the source point reports the number of barrels metered into the system, the tapes are moved forward by that amount, feeding in through a slotted entry in the surface of the coard at the source point marker. By this means, the pipe line shows the correct fill at all times for the hour to which the tapes are pulled.

Tape Is Cut

When a delivery is begun at any point, the tape from which the delivery is being made is cut, and each hour that the delivery is in progress, the downstream end of the cut tape is lapped over the upstream end by the amount that the delivery terminal reports has been metered out of the system during that hour. By this means, the tape moves at the correct speed, or the correct distance, both upstream and downstream of a delivery point where product is being removed from a batch. (See Figs. 5 and 6).

When a dispatcher wishes to determine the arrival time of a batch head at any point along the system, he may do so by placing the index of an engineers' scale which is calibrated at 20 points per inch on the marker representing the point at which he wishes to calculate arrival time and measuring back to the batch head as represented by the tape for that batch. By dividing the figure in barrels thus secured by the rate which he knows that he will maintain through that section for any given period, he secures a figure in hours and minutes which may be added to the hour to which the tapes were pulled at the time of measurement and accurately predict the arrival time of the batch head at the point in question. This method is very accurate and it is possible to predict batch changes at any point to a tolerance as small as 1 minute. Differences of as much as 5 minutes between predicted batch change (or batch head arrival) times and actual batch change times are unusual.

The upper part of the board is fitted



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with a backboard on which attached sheets of ruled plastic are etched with the profile of the line and the major block valves along the system. Directly below the profile of each line, a system of colored lights is provided for indication of the operations which are in progress on that line. (See Figs. 2 and 3.) Each pumping unit is indicated by a red light, each delivery terminal by a green light, and each sump pump at a station or terminal is indicated by an amber light. Doraville station is also fitted with two blue lights which are used instead of the normal red lights when the station is pumping product from the tanks at the Southeastern Pipe Line tank farm at that point.

The lights are controlled by switch boards fitted with identical lights and toggle switches. The lights on the switch boards and on the dispatching board are connected in parallel so that if a bulb in either place is burned out, the corresponding bulb in the other will not burn when the toggle switch is thrown. The switch boards are located adjacent to the teletype machines for each line in order that the dispatcher may operate them without leaving his seat at the teletypes. (See Fig. 7.) The use of the light system not only affords a means for the dispatcher to keep track of the unit setup which he is operating, but it also affords a means of keeping track of units knocked off or brought on the line during simultaneous or repeated power failures caused by storms, lightning, etc., at several points along the system and the resultant shutting down and starting of other units to compensate for the pressure variations which are induced. The system also provides a means for the department supervisory staff and visitors to instantly grasp a picture of the operations in progress without the necessity for disturbing the dispatcher for an explanation.

The lower section of the board is fitted with drawers for the storage of the rolls of product tapes, and shelves for miscellaneous storage of other materials. For the sake of appearance, the drawers and shelves are concealed by sliding doors. The upper shelf is kept clear to receive the tapes of products which have completed their passage through the system. These tapes enter the body of the board through a slot at the terminus point of each line. Each line is handled separately on the board in the same fashion as it would be if it were an entity in itself.

When the dispatcher comes on tour, he is reviewed by the dispatcher whom he is relieving on the operations which are in progress or which will shortly be in progress. He then turns to the board, and, using the daily pumping order as a guide, calculates the batch changes, operations changes, deliveries, and all other pertinent data for the lines under his control. He transmits this information to the field via teletype, covering the 8 hours of his trick and the first 2 hours of the next succeeding trick.

Each hour, all stations and all terminals at which deliveries are in progress report by teletype as to the barrels pumped into the line in the case of source points, the barrels metered out of the line in the case of delivery points, and the station pressures and other data in the case of pumping stations. The dispatcher records this information on a stream sheet as it is received. The stream sheet is kept in mathematical balance on an accumulative basis. After the information for all points is received and recorded and the sheet brought into mathematical balance each hour, the dispatcher transfers the information to the stream tapes on the dispatching board.

Periodically through his tour of duty, he checks the information which he has sent to the field at the start of his trick, transmitting corrections and revisions to the field by means of the teletype. The remainder of his time is occupied by the giving of orders for the starting and stopping of units, changes in operational setups, starting and completing deliveries, etc.

The dispatching board was designed by the Plantation engineering department in accordance with suggestions from and requirements of the dispatching department personnel. It is constructed entirely of aluminum alloys, and was built by a local firm under the supervision of Plantation engineers. The board is built in two 9-ft. sections, and is of bolted construction throughout so that it may be almost completely disassembled should it be found necessary to change its location. The lighting system operates on a 110-volt circuit, and two stepdown transformers are contained in the backboard to reduce the voltage to that at which the small lights operate. The present board has been in service for nearly 2 years and has proved to be extremely satisfactory. It has been found to provide as nearly errorproof a system as it is possible to devise. The only possible sources of error lie in the posting of the information or in the care exercised in the calculation of information which it affords. Its accuracy is nothing short of phenomenal when properly used. Both the scheduling and dispatching systems described above have been in use with only slight variations at Plantation for nearly 8 years, and serious errors have been so few as to be nearly nonexistent.

References

1. Plantation System Advances Pipe-Line Procedures, by Paul Reed, The Oil and Gas Journal, July 28, p. 136, August 11, p. 81, and September 1, 1945, p. 53.

2. More Arteries for Petroleum, by M. A. Hyde, The Westinghouse Engineers, August 1942.

3. Contamination Control in Products Pipe Lines by Edwin A. Birge, The Oil and Gas Journal, September 20, 1947, p. 176.

Transcontinental System

(Continued from page 184)

for weld and construction and will be shop fabricated into units with a 9-ft. section of main-line pipe welded on each end. These short sections of pipe will have a wall thickness of ½ in. for reasons of stability and safety. Block valves between compressor stations are being furnished by Nordstrom. All compressor-station block valves and side-gate valves are being furnished by W.K.M. The W.K.M. valves installed at stations will be equipped with Limitorque automatic opening and closing mechanisms.

The design of the line contemplates the installation of approximately 210,000 hp., divided approximately equally among 20 stations. The average station spacing is about 80 miles. This will result in an over-all pipeline sales capacity of 505,000,000 standard cubic feet of gas per day. It is contemplated that it will be possible to use flare gas as fuel for those stations lying south and west of the Mississippi River.

The eastern section of the line, particularly from a point near Linden, N. J., to the terminus at the Hudson River and 134th Street in New York, passes through a highly developed industrial and residential area. Pipe-wall thickness for this section of the line will be a minimum of .375-in. thickness through the sparsely populated and industrial areas and .500-in. wall thickness through the heavily settled areas and where the line is laid under city streets, highways, and railroads, and past industrial plants and like areas. The operating pressure in this eastern section of the line will be reduced by a regulator and control station to be installed near Linden for controlling the pressure to a maximum of 400 psig.

River Crossings

Generally speaking, all streams and rivers, with the exception of the larger and more hazardous rivers, will be crossed with a single-line submerged type of crossing having the same diameter as the main line at the point of crossing. In the section of line being constructed during the 1949 construction program, the Coosa in Alabama and the Atchafalaya in Louisiana will be crossed with the pipe supported by an aerial pipe-line suspension bridge. Each of these structures will be designed to carry two 30-in. diameter by .375-in. wall thickness lines. It is presently contemplated to install, initially, one line on the Coosa bridge and two lines on the Atchafalaya bridge. The Coosa bridge is designed for a length of 700 ft. and a minimum clearance of 52.7 ft. above the water; the Atchafalaya for a length of 3,650 ft. and a clearance of 66 ft. above the water.

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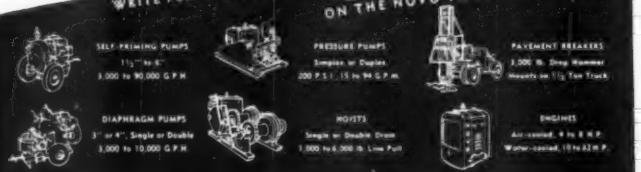

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two 24-in. lines. This river crossing will be the submerged type with the pipe being of the wall thickness required for negative buoyancy without the use of river clamps or other added weight. The pipe being used is seamless 24-in. o.d. having a wall thickness of 0.937 in.

Design work has been completed for the Hudson, Hackensack, and Passaic river crossings. It is contemplated that the installation of these crossings will be started during 1949. The Hudson River will be installed as a single-line crossing of 26 by 1.125 in. wall thickness pipe. The bottom of the Hudson River consists of a silty mud which is in a semifluid state. The weight of this material is approximately 90 lb. per cubic foot or a specific gravity of 1.44. The lack of a solid bottom in this river creates an interesting design problem similar to that encountered in the design for the vehicular and railroad tunnels.

The Hackensack and Passaic rivers will each be crossed by a single 26-in. line, with provision made in the Passaic crossing for a second 26-in. line to be added at a future date. Both of these rivers have solid bottoms and the installation will be of normal type and design.

The pipe for these rivers will be of sufficient wall thickness to satisfy negative buoyancy requirements. No river clamps or weights will be used. The depth of cover at the Hudson River is designed for 25 ft. This will eliminate the possibility of accidents due to ships dragging anchor or other extraneous considerations. It is contemplated that the line can be jetted into place by the use of water jets. The west bank will have the usual normal river landing. The line will terminate at the east bank and be anchored to steel piling driven into the river floor just outside the bulkhead line. All river crossings in this area will be protected from corrosion by somastic coating and slatting.

Field surveys of other river crossings along the main line are being made at the present time, and the detailed design will be developed for each individual crossing. In general, it is the intention to cross with single-line crossings wherever possible, using as heavy wall pipe as practicable. The second Hudson River crossing encountered on the main-line extension to the New York-Connecticut state line has not yet been surveyed and designed. A tentative crossing has been selected and will consist of a single 20-in. submerged crossing.

Pipe-Line Construction

Construction of Transcontinental facilities as stated before has been generally divided into two major parts, namely, a 1949 and 1950 construction program. Construction schedules call for the completion of the entire system by the end of 1950, which is well in advance of the com-

pletion date required by FPC. The 1949 program consists of the installation of approximately 608 miles of main line and five main-line compressor stations. This section of main line is located between Eunice, La., and Athens, Ga., all being 30-in. diameter. Stations Nos. 6, 9, 12, 15, and 18, located near St. Francisville, La.; Demopolis, Ala.; Atlanta, Ga.; Davidson, N. C.; and Orange, Va., respectively, will be installed this year. In addition to the above, it is planned to construct some main line in the New Jersey area and prepare the right-of-way across the salt meadows for construction where right-of-way is available, together with the Hudson, Hackensack, and Passaic river crossings.

The 1950 construction program will consist of the balance of the system of approximately 965 miles of 30-in. main line, 5 miles of 26-in., 192 miles of 24-in., 26 miles of 20-in., 43.5 miles of 14-in., and 35 miles of 10-in., plus the additional 488 miles of supply and sales lateral lines.

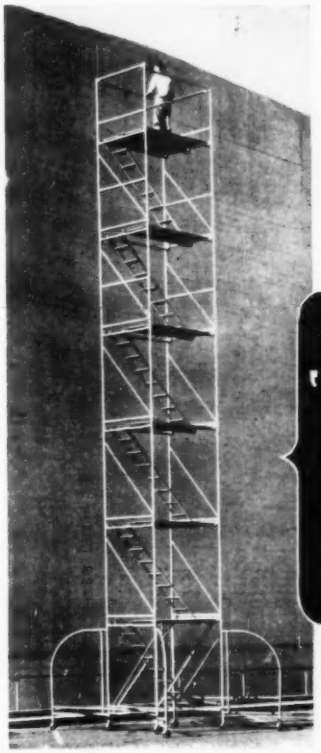
The present pipe-line construction is divided into six schedules of approximately 100 miles each. The 1950 work is divided into schedules of approximately the same length. Present plans indicate some 12 to 15 pipeline construction schedules will be required simultaneously in the 1950 program to meet the required schedule, as compared with the 6 schedules under progress at the present time.

Pipe bending is accomplished by both the smooth and wrinkle-bend technique. Both methods were carefully investigated prior to starting operations and each was found to be satisfactory.

Specifications covering the pipeline construction generally call for a minimum cover of 30 in. with extra cover as required for swampy and submerged areas. Less cover is provided for rock areas where excavation is difficult and expensive. Type A pipe coating, using coal-tar primer, enamel, and Fiberglas wrap, is used throughout the entire line, with the exception of the most severe corrosive areas where Type B coating, consisting of an additional coating of enamel and asbestos-felt wrapper, is being used. Somastic coating will be used on that section of the line traversing the highly industrialized and thickly populated areas from Linden, N. J., to the terminus.

On that section of the line traversing terrain which is cut up by gullies, the design specifies that such gullies be spanned and the pipe laid from bank to bank of the gulley in spans up to approximately 100 ft. Results today indicate that this practice is acceptable in every way and effects appreciable economies.

Pipe is being furnished to the line in 31-ft. length joints. In order to reduce field welding to a minimum and eliminate the usual flaws result-



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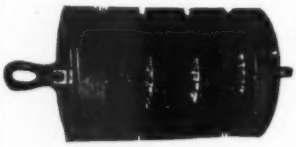

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ing from hand or manual work, double-jointing operations have been used on three schedules of the 1949 construction program. Double-jointing operations are carried on with the use of automatic welding machines located at pipe-storage yards, having from 10 miles of pipe to a maximum of 23 miles per location. This operation has proved quite satisfactory and successful and meets with the contractors' requirements in every way.

The pipe-line system is designed for the installation of cathodic protection. Cathodic protection units will not be installed during the construction period, but rather will be installed shortly after construction during the first or second year of operation. Ground wires are being attached to the main line at 1-mile intervals. This will provide a means for making a study of electrical losses on completion of the system. It is anticipated that cathodic units can be spaced at 25-mile intervals and will mainly use purchased power from intersecting electrical facilities. Where this is impossible, a small gas-engine-driven generator set will be installed to provide the power for the cathodic unit.

Compressor Stations

The development of the pipe-line system for the delivery of 505,000 M.c.f. per day of gas sales at the Eastern Seabord area will require the installation of 20 compressor stations. The main line stations from No. 5 to No. 12, inclusive, will each be of 12,000-hp. size, consisting of five Cooper-Bessemer GMW-type 10 units of 2,400 rated horsepower. Stations 13 to 20, inclusive, will each be of 11,200 hp., consisting of seven Clark Brothers BA-8 units size 1,600 rated horsepower. The remainder of the stations will be of lower horsepower, as determined by the supply of gas to the system. All compressor units will be equipped with the new type of high-compression turboflow power cylinder heads which are guaranteed by the manufacturers to have a maximum fuel consumption of 8,500 B.t.u. per boiler horsepower-hour.

Each compressor station will be equipped with oil bath-type dust scrubbers on the incoming gas line to the station, and all gas will be cooled after compression. Engine-jacket water cooling on all stations will be accomplished in air-cooled sections, which materially reduces the size of the cooling tower required, as this represents the major heat load in the compressor stations. Only a minimum of gas cooling will be done, and this will be accomplished by atmospheric sections placed in the base of the cooling towers.

The gas intake and discharge lines, together with the suction and discharge headers at the main-line stations, will be 30-in. diameter to accommodate the full capacity of the main line.

Electricity will be generated by gas-engine-driven generator units at each of the stations for furnishing the required electric power for operating auxiliaries such as water pumps, air compressors, air-cooled section fans, cooling tower fans, etc., and plant lighting. Three 250-kw. generating units will be installed at each of the main-line stations.

All valves in the high-pressure gas piping at each of the stations will be welded into the piping, and only a very minimum of flanges in such high-pressure gas piping within the station yard will be used. Such flanged joints will be principally confined to connecting to compressor cylinders, gas-cooling sections, dust scrubbers, and where required, to isolate the various piping sections. It is estimated that this will not only result in a substantial saving on the installed cost of the stations, but will also eliminate the possibility of flange leaks and gasket trouble.

Each station will be a self-contained unit and will not be dependent upon other sources for its supply of water, electricity, and like utilities.

All plant piping, with the exception of sewer and drain piping, will be installed aboveground, either overhead on pipe supports or off the ground on concrete piers. This will also apply to conduit for power and light circuits, which will also be in-

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stalled on the overhead pipe supports.

General

All gas introduced into the main line will be dehydrated to a maximum water content of 7 lb. per M.M.c.f .to prevent hydrate formation. Dehydration plants will be located at the various gas fields supplying the line and will be of the solid type.

The communication facilities for the operation and maintenance of the system will be through leased telephone circuits and will be augmented by radio telephone with relay stations installed at the various compressor stations and other points where required.

All pipe lines, both main line and lateral lines, will be thoroughly cleaned before testing by passing a scraper or "pig" through the line to remove dirt, mill scale, water, and debris. After cleaning, the line will be pressure tested to the designed working pressure.

Maximum efforts are being concentrated on constructing the system from near Eunice, La., to the various delivery points in the east. Eunice being the tie-in point of the farthest east gas supply lateral to the system. This will permit the earliest delivery of gas from the system to the market and the complete balancing out of the system while the remainder of the pipe-line system is being constructed southwest of Eunice to the other various gas fields supplying the system. The present schedule is for the delivery of all pipe and the construction of all facilities on this basis. Approximately 50 per cent of the main line from Eunice to the market will be constructed during the 1949 construction program, which will be that section of the line from near Eunice to Athens, Ga. This section of the main line will be thoroughly cleaned and tested and will be finished as a complete section by the end of this year.

PREDICTIONS . .

(Continued from page 185)

Over the years, the design of pipeline pump stations has progressed so far that today various types of prime movers can be used with different pumping units. Wherever electric power is available at reasonable rates, the motor-driven centrifugal pump is the choice of most engineers for average-grade crudes and refined products. For heavy fuel and more viscous crudes, the reciprocating-type pump—either horizontal or vertical—is still in favor. Many stations use diesel engines to advantage, as in most cases the fuel can be taken from the line after proper settling, centrifuging, and filtering. Gas engines are adaptable near producing fields, or where natural gas is readily obtainable.

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controls are now applied to the temperatures, pressures, and flows, so that the number of men required is small in comparison to the millions of barrels moved through the lines each day. Closed engine-cooling systems for internal-combustion engines have proved very effective, and considerable progress is being made to utilize more of the heat which has previously been wasted through the jacket water and engine exhaust. Better cooling methods, combined with air filters and higher grade lubricating oils, have resulted in higher thermal efficiencies and considerably lower fuel costs. This is especially true in connection with the gas-diesel, which has been developed by several engine builders. This unit can operate efficiently with 10 per cent diesel oil and 90 per cent gas, and can be thrown over to full diesel at any time. This is a real advantage to gas pipe lines when it is desirable to conserve the gas flowing through the line for their customers during the coldest part of the day. The gas-diesel engine is likewise helpful to oil pipe lines, where gas produced with the oil in nearby fields can be used in the pump stations—thus conserving fuel oil.

In thinking of pipe-line design and operation, the average person might conclude that these systems which are so carefully laid out and substantially built, can continue to operate efficiently over a long period of time without further concern on the part of the owners. This is definitely not the case, as pipe lines—along with other types of business—must continue to improve their methods and lower their operating expenses, so as to deliver the products to the consumer at a reasonable cost. This is a continual challenge to the management and a wonderful opportunity for men with inquiring minds to devise better ways of doing things. There are so many chances for improvement in pipe-line technique that several predictions might be made.

Need for Inhibiting Substance

1. The gasoline lines, which have so effectively used inhibitors to protect the inside of the pipe, as well as to increase the flow through the smoothness produced, need an inhibiting substance which will give a permanent skin effect to the metal. This does not seem out of reach, as case hardening of steel has been employed for many years. Someday someone will find a solution that can be injected into the gasoline line to give a beneficial and lasting effect to the inside of the pipe.

2. The protection of the outside surface of a steel pipe line has already been mentioned, but it still remains for the steel companies with vast research facilities to make a pipe that will have a stainless outside surface. This will eliminate the need for protective coatings, and make the use of the cathodic or magnesium methods unnecessary. There is a real challenge to the steel people to produce rustless pipe at a reasonable cost. Steel pipe has proved satisfactory for conveying petroleum and its products for many years, but there is still a possibility that aluminum or some other metal, as well as plastic and fiber pipe, may enter the picture for limited use—depending mainly on whether or not the makers can develop a satisfactory field joint that will be as smooth and strong as the pipe itself.

Better Water Removal

3. The gasoline pipe lines are now using cylindrical tanks filled with excelsior, or other types of filter, to remove the water as well as sediment—which is generally referred to as "rouge." Rouge is a combination of rust and foreign particles, so fine that it is very difficult to remove from the stream of gasoline. If not removed, the rouge is damaging to the valves and other types of apparatus, as well as to the moving parts of the pumps. The present procedure is effective under most conditions, but it is a batch method which requires periodical refilling of the filter tanks. The refined-products pipe lines need a continuous method of filtering

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which will have an even efficiency of extraction of all foreign matter from the gasoline. This is being worked on continually, and may be solved someday by mechanical or electrochemical means.

4. There still remain many chances for design engineers further to develop the remote - control pipe - line pump station. For example, this can be built as a booster midway between two main pump stations, so that it will automatically come on the line or drop out as the pressures and flows determine. This would be desirable at some inaccessible place along the main line, where storms make ordinary roads difficult or impassable. This type of station could be housed in a steel-concrete building, and protected from view, or actually built below the ground. All of this should be worked out to promote efficient, continuous operation under safe conditions.

Opportunities for Improvement

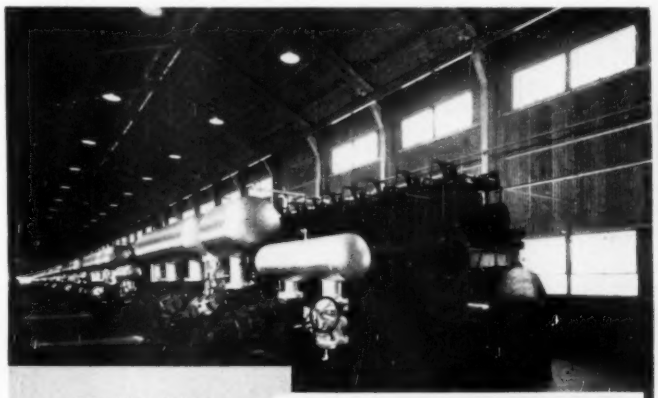
5. There are opportunities for the engine builders to continue the development of internal-combustion engines of even higher thermal efficiency than the best types built today. Research along these lines goes to show the possibility of vapor-phase cooling, or some similar method which will improve the engine performance. This will have considerable economic impact on pipe-line operations, as both crude and gas lines, as well as many refined products systems, use internal-combustion engines.

6. In considering pumps for new pipe-line stations, the multicylinder variable-stroke type is coming more into use, although changeable-speed pumps have similar advantages. The general arrangement of most modern stations favors series operation as compared to separate units running in parallel. All connections to the pumps should be streamlined, and should avoid pockets in order to decrease contamination in batching and to provide freedom from surges. Recent studies indicate that surges can be damaging, especially in large-diameter lines, if uncontrolled.

7. The arrangement of station piping has been controversial for many years, but the general trend is in favor of aboveground construction. This makes it possible to watch the manifolds and headers for leaks or possible breaks, and makes it easier to repair them. These surface lines are more convenient to keep painted and clean at all times. Exposed pipe, well anchored to concrete bents, avoids the possibility of undetected breaks underground—either from vibration or leaks through corrosion—which might cause a bad accident or fire. In connection with station piping, cellars or pits should be avoided as they carry some risk In addition, surface drainage should be so arranged that a break in a line or manifold will not allow the oil to flow toward the station.

8. In over-all station design, the main consideration is continuity of service, with due regard to initial cost, fuel economy, and low maintenance expense. This means that the station should be built substantially but not extravagantly, to withstand severe winter weather if in the North, or heavy storms in the South. A pipe-line pump station, generally, is a safe place to work, if it is provided with proper ventilation and has no basements where gas might collect and ignite. Good lighting and adequate heating must be provided, together with proper space for men to operate and maintain the units. The welfare of the men is a very important consideration, and they will have pride in a neat well-designed station, and will operate it to the credit and profit of the owner.

Good engineering and sound business judgment, resulting in economical operation of the pipe-line systems, as well as pleasant employe relations, go a long way to insure the success of private enterprise—whose main objective is to serve the public at the lowest cost consistent with a fair return on the valuation of the properties involved.



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The Roughness Problem

(Continued from page 195)

In gravitational units, the data reduce to:

$$\rho = \frac{62.5 \times 0.85}{32.2} = 1.65 \text{ slugs per ft.}$$

$$\mu_{c.u} = \frac{0.0672 \times 0.85 \times 0.1}{32.2} = 0.000177$$

G-Rheyns

$$\gamma = 62.5 \times 0.85 = 53.1 \text{ lb./ft.}$$

D = 1.021 ft. l = 264,000 ft., and

$$V = \frac{Q}{3.51d^2} = \frac{3,000}{3.51 \times 150} = 5.70 \text{ ft./sec.}$$

Then:

$$N_R = \frac{DV\rho}{\mu} = \frac{1.021 \times 5.70 \times 1.65}{0.000177} = 54,300$$

$\lambda = 0.021$ and

$$p = \frac{\lambda l \rho}{D} \frac{V^2}{2g}$$

$$= \frac{0.021 \times 264,000 \times 1.65 \times 5.70^2}{1.021 \times 2}$$

p = 145,500 lb./ft.^{2} = 1,010 psi.

B. What is the flow rate corresponding to a given pressure drop of 145,500 lb./ft.^{2}

$$\nu = \frac{\mu_{c.u}}{\rho} = \frac{0.000177}{1.65} = 0.0001073, \text{ and}$$

$$N^a = \frac{1}{2\nu} \sqrt{\frac{pD}{l\rho}}$$

$$= \frac{1}{0.0002146} \sqrt{\frac{145,500 \times 1.021}{264,000 \times 1.65}}$$

$$= 2,780$$

From Fig. 3: $a = 19.5$. Then:

$$q = \frac{a\pi}{8} \sqrt{\frac{pD^5}{l\rho}}$$

$$= \frac{19.5 \times 3.141}{8} \sqrt{\frac{145,500 \times 1.021^5}{264,000 \times 1.65}}$$

q = 4.66 ft.^{3}/sec. = 2,995 bbl. per hour, which agrees.

C. What diameter pipe is required for a capacity of 3,000 bbl. per hour through a level line 50 miles long?

$$N_R = 1/\nu \, (\tfrac{1}{\pi} q / l\rho)^{1/2}$$

$$= \frac{1}{0.000177} \sqrt[3]{\frac{145,500 \times 4.66^2}{264,000 \times 1.65}}$$

N_R = 18,850. Then by Fig. 4:

N_R = 55,000 and $\lambda = 0.021$ and

$$D = \lambda l \rho / p \, V^2/2 = (8/\pi^2 \, \lambda \rho l q^2/p)^{1/5}, \text{ (ft.)}$$

$$D = \sqrt[5]{\frac{8 \times 0.021 \times 1.65 \times 264,000 \times 4.66^2}{3.141^2 \times 145,500}}$$

D = 1.02 ft. = 12.25 in., which agrees.

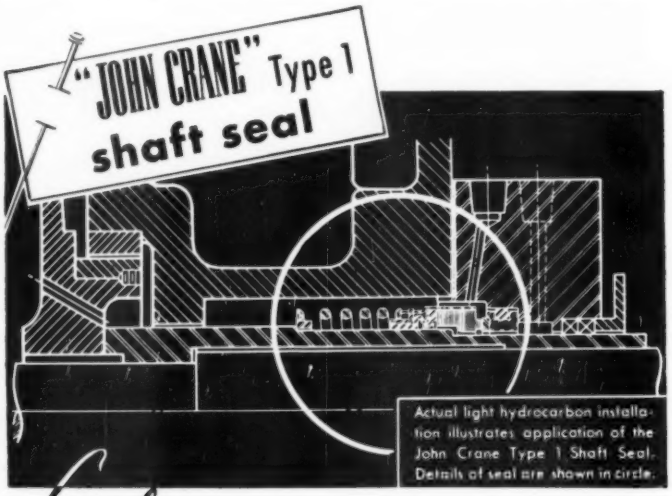
Note: The choice of the correct λ from Fig. 2 is indicated by:

$$N_R = DV/\nu = 4q/\pi D\nu = 55,000 \therefore$$

$$D = \frac{4q}{55,000 \, \pi \nu}$$

$$= \frac{4 \times 4.66}{55,000 \times 3.141 \times 0.0001073}$$

D = 1.005 ft.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Reversible Pipe Line

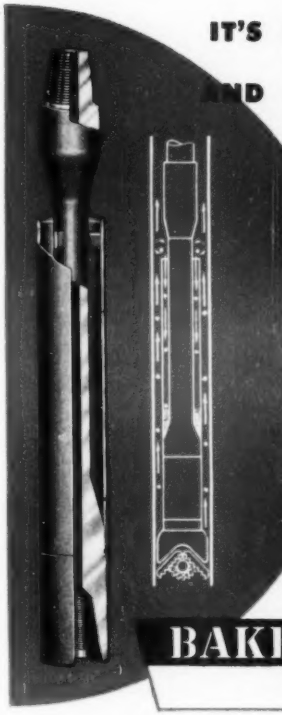
(Continued from page 198)

Manifolds were designed for minimum contamination in spite of complicating factors occasioned by the reverse flow. Provision for reversing the flow was accomplished by providing dual check valves mounted in opposite directions. This permits bypassing the intermediate station in either direction. All manifolds are provided with swing lines equipped with Chiksan swing joints and Unibolt couplings which permit connection with individual lines to and from each storage tank and which provide for all tank changes to be made at the station manifolds. All products pumped pass through wood, excelsior-packed, tank-type strainers for removal of entrained moisture and sediment.

Periodical running of scrapers was initiated at the time the line was placed in service. However, a steady decrease in throughput was noted, and, after approximately 1 year, scale had accumulated in the line to the extent that on two occasions the line was completely plugged with scale pushed ahead of the scrapers. One section of pipe, 90 ft. in length, had to be cut out of the line and the entire length was found to be tightly packed with solids. Since this occurrence, a sodium nitrite and caustic inhibitor has been injected into the line with excellent results. "C" factor is gradually increasing with resulting increase in throughput and it is expected that we will be able to discontinue the use of scrapers entirely in the near future.

The three pump stations are housed in permanent red brick buildings, providing an office, pump room, and engine room. Each station is equipped with an eight-stage 6 by 4-in. Pacific centrifugal pump, operating up to 3,750 r.p.m. driven through a 5.85 to 1 Lufkin speed increaser by a heavy-duty Alco 12½ by 13-in. six-cylinder engine rated at 540 hp., 600 r.p.m. Engines are operated on the dual-fuel principal, only sufficient diesel fuel oil being used to provide for ignition of the natural gas. Jacket-water cooling is by heat exchange with the product being pumped. A vertical heat exchanger is located on the suction side of the pump under the pump room floor. Supplemental cooling is provided in the form of induced-draft air coolers at stations pumping heavy gas oil, due to the high viscosity of this material and the resulting low heat-transfer rate.

Engine pumping speeds are controlled automatically by air-actuated pressure controllers, control being by either station discharge or suction pressure. Engine speed increases until a maximum preset discharge pressure is maintained unless suction pressure falls below a preset minimum, in which event engine speed is decreased to maintain the minimum



IT'S **SIMPLE**
AND **PRACTICAL**

The Baker Junk Basket aids in removal of cuttings when drilling up dense but "drillable" materials such as cast iron, magnesium alloys, bronze and similar materials used in the Baker Cement Retainer and other drillable devices. ★ The Baker Junk Basket is positioned in the drilling string just above the bit. ★ Circulation fluid raises cuttings to the top of the basket, at which point the velocity is greatly reduced when it reaches the larger annulus (circulation area) due to the smaller diameter of the drill collar. ★ This sudden reduction in carrying (lifting) power of the circulation fluid causes the cuttings to drop into the basket where they are trapped. ★ See your BAKER (or Composite) CATALOG for details and specifications; or write to Baker Oil Tools, Inc., at Houston, Los Angeles, or New York.

BAKER JUNK BASKET

PRODUCT NO. 428

WILLIAMS-AUSTIN COMPANY

PIPE LINE CONTRACTORS

OIL-GAS-GASOLINE

WATER PIPE LINES

GRANT BUILDING

PITTSBURGH 19, PA.

G. A. Manuel Len Hinson Ed Peters

Welding scene on 26-inch gas line being laid in North Louisiana.

LATEX CONSTRUCTION COMPANY

General Contractors

OIL — GAS — GASOLINE — WATER PIPE LINES

HOUSTON, TEXAS — ORGANIZED 1936 — ATLANTA, GEORGIA

Laurence H. Favrot — Geo. A. Peterkin — J. W. Sharman — R. P. Gregory

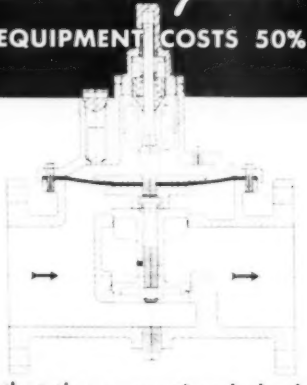
ENARDO *Has Done It Again!*

IMPROVED PIPE LINE SHUT-OFF VALVE REDUCES EQUIPMENT COSTS 50%

CHECK THESE ADVANTAGES!

- POSITIVE ACTION
- FULLY AUTOMATIC
- INCREASES PUMP EFFICIENCY
- CONSERVES EQUIPMENT
- KEEPS AIR OUT OF LINE
- CONTROLS BACK PRESSURE
- SHORTENS RUN TIME

It Eliminates Need for Regular Check Valve



The dependability of Enardo's 1950 Series Pipe Line Shut-Off Valve has been improved. It now acts as a positive check valve also, so that the conventional check valve is no longer required in the gathering line.

WRITE ENARDO FOR MORE DETAILED INFORMATION.

BOX 1647 — TULSA, OKLAHOMA

ENARDO *Manufacturing Co.*

TULSA, OKLA.

suction pressure required to keep the pumped filled. Booster pumps located at the storage tanks provide a positive suction head for the main line pumps.

Remote-reading, automatic tank gages are used on all tanks to provide accurate and convenient means of making hourly checks of quantity pumped and received. This equipment in conjunction with the sensitive station control equipment makes any irregularities of line operation readily apparent to the operator. Line breaks or leaks are immediately detected by pressure drop at one of the stations. Line losses have been held to a satisfactory minimum since operation began.

The pipe was coated with coal-tar enamel and wrapped to a total thickness of 5/32 in. when laid and insulated from all other structures. Cathodic protection is provided by three rectifiers, equally spaced along the line at locations determined by soil surveys and proximity to power lines. It is expected that with this protection external corrosion will be negligible.

High Throughput

(Continued from page 226)

To insure safety in shooting a pig or cleaner from the line, Panhandle Eastern Pipe Line Co. has adopted the use of a check joint at the end of the line to catch the cleaner when it emerges. The check joint is made up of material generally available on all construction work. The need for such a method is readily seen when it is realized that the cleaner moves through the line at from 30 to 60 m.p.h. and leaves the end of the pipe with considerable force. Serious accidents could result from a pig shooting unchecked from the end of an open line.

A check joint, with slotted perforations, set loosely in a coupling at the downstream open end of the line will move only a short distance when the cleaner enters it. This not only protects anyone from being injured, but also protects the cleaner from damage. When the cleaner enters the check joint, this joint will detach itself from the coupling center ring and slide forward 10 to 15 ft. flat on the ground. Usually it falls clear of the end of the pipe from which it was detached and the blowing of the line can follow immediately. If it should happen that the detached check joint obstructs in any way the blow of gas following the pig, it should be pulled to one side before blowing the line.

For sections of large-diameter lines, 8 to 10 miles long, it is necessary to blow for 2 to 6 minutes through a 6-in. bypass gate with 300 to 500 psi. behind it in order to remove all loose dirt and dust.

Satisfactory results have been had by Panhandle Eastern Pipe Line Co. in perforating the check joint in the manner shown in the diagram.

Slot measurements and their spacing are shown for pipe of different diameters in the following table:

CHECK JOINT SLOT AND SPACING

(Slots and spacing indicated by letters are in positions shown in diagram. Measurements are in inches).

Diameter—	A	B	C	D	E
12	10	2	3	5	8
16	12	3	4	7	8
18	15	3	5	8	6
20	15	4	5	9	10
22	18	4	6	10	12
24	24	4	7	11	18
26	24	4	8	12	18
30	24	5	9	14	18

The check joint has a blind disk in the coupling bolted at the downstream end. The blind disk has a ¾ by 12-in. slot near the bottom to vent air from the joint. On the downstream end rubbers are used in the coupling. The upstream end is fastened by a coupling with two bolts with rubber only in the upstream side.

When lines are to be taken out of service to clean there are certain phases of the work that can be done previously to the actual cleaning operation. Flow tests will indicate the sections of line that are low in efficiency and need cleaning. Several weeks before cleaning actually starts, these sections are prepared for cleaning as follows: A joint of pipe is uncovered at each end of the section and approximately 300 ft. from the gate valves. Bell holes are completed for removal of the joint and the joint is weighted with sacked dirt. A wire sling made from hog wire fencing is placed over the pipe where the weight is to be placed. The ends of the sling extend up and out of the ditch far enough on each side to permit the fastening of a pipe or timber to the loose ends. The sacked dirt is then placed in the ditch on top of the pipe and sling.

All sections that are included in the cleaning program are prepared in this manner before any cleaning is started. This greatly facilitates the actual cleaning operations in that there is no excavation to do and the weight is quickly removed by the use of a truck with an "A" frame and winch line. Even though the sacks have been on the line long enough to deteriorate, the sling will contain the dirt when picked up by the winch line which is hooked into the two pipes or timbers fastened to the sling.

The preliminary work being completed, the cleaning is started by blowing down the section to be cleaned and removing the weight from the exposed joints at each end of the section. The upstream joint is removed, cleaner inserted, and the joint replaced in the line. Simultaneously the 40-ft. joint from the downstream end is removed, the ditch crumbed out, and one end of the joint is replaced in the ditch and joined to the line to be cleaned with a center ring of a long sleeve. The other end of this joint is elevated on skids so that it is approximately 2 ft. higher than the ground level. A winch line from a truck is fastened around the middle of this joint and the truck placed on the backfill 100 ft. or more upstream. Taking up the slack and locking the winch in place will hold the 40-ft. joint in place when the cleaner hits it. The check joint is then placed on the end of the joint coming up out of the ditch as previously outlined.

The line is then purged slowly through the cleaner from the upstream end, care being taken not to move the cleaner during the purge. When all air has been removed from the line for a distance of a mile or more ahead of the cleaner, the pressure is raised quickly, starting the cleaner through the line. A pressure of 3 lb. to 10 lb. above the starting pressure is generally enough to keep the cleaner progressing at a steady rate.

The reading of the gage at the upstream end of the line (where the pressure to run the cleaner is controlled) is made easier if a long copper tube is used between the pressure tap and the gage with a small dampening pot inserted in the tube ahead of the gage. This insures that the pin will be steady so that the man handling the gate valve is enabled to maintain the proper pressure against the cleaner at all times.

An observer at the downstream end of the line, who is in continual radio contact with the man at the pressure controls, can determine the progress of the cleaner by watching the gas flow and report any irregularity which might call for more or less propelling pressure. If the amount of scale and rust being carried by the gas diminishes sharply, it is a good indication that the cleaner has become stuck. This has happened occasionally when the cleaner enters heavy-wall pipe used for highway or railroad crossings. When this happens the expansible feature of the clearer is utilized. The cleaner is allowed to collapse by reducing the pressure and a quick surge in pressure will start the cleaner moving again.

Although this type of cleaner has been used through several hundred miles of line, no accurate measurement of foreign matter has been or can be obtained. A considerable amount is carried out in the gas stream while the heavier particles are trapped in the check joint or emerge through the slots and fall to the ground. Approximately 1,500 to 6,000 lb. of mill scale will be removed besides other foreign matter in cleaning 8 miles of new 26-in. line, depending on the make of pipe.

Since cleaning operations are essentially simple when carried on with adequate practices and equipment, it is easy to overlook their importance for natural-gas pipe lines.

Major Pipe-Line Construction Projects

by Paul Reed

PIPE-LAYING operations have increased lately to such an extent that 1949 operations are likely to total 15,000 miles for petroleum and natural-gas systems in the United States and abroad.

Projects announced in the last few months bring the total of world construction planned for the future up to 35,560 miles. Domestic natural-gas programs lead with 17,700 miles to be laid in the next few years. Planned domestic petroleum projects total 7,750 miles, of which 4,780 miles will be for crude oil and 2,970 miles for products. In foreign countries 10,110 miles are in prospect. In addition there are some important domestic and foreign projects now in the planning stage for which announcements have not yet been authorized.

Continuation of pipe-line construction on a large scale promises to continue because of strong economic factors requiring pipe-line extension and enlargement. Contrary to a general supposition, loops and extensions promise to entail greater mileage than laterals in future construction.

There is a trend toward continued big-inch looping of long systems transmitting natural gas from the South to northern areas. Such looping continues from year to year. In 1949 Tennessee Gas Transmission Co. is laying approximately 400 miles of loops; in 1950 the program will be doubled for looping 800 miles. Texas Eastern Transmission Corp. will lay 1,400 miles of 30-in. loop next year. More than a year ahead of possible completion of its 2,220-mile, $190,000,000 system, Transcontinental Gas Pipe Line Corp. is planning for additional expenditure of $50,000,000 for compressors, loops, and extensions.

Wisconsin to Get Natural Gas

High-priced coal now makes natural gas competitive not only in present markets but also in areas where it has not yet been available. This year Wisconsin will get its first large deliveries of natural gas with completion of Michigan-Wisconsin Pipe Line Co.'s system to Milwaukee; this company is completing its line to Michigan which will increase natural-gas supplies to the Detroit area. Lines are being planned for New England which has never had any natural gas. Potential markets in large centers like Chicago and New York will be only partially served by existing systems and lines now under construction.

Several major crude-oil pipe-line companies are planning large big-inch projects for paralleling existing systems both in the South and in the North. Humble Pipe Line Co. has already announced plans for getting the economic advantages of big-inch operation by laying the West Texas-Gulf Coast 375-mile, 18-in. line in 1950. Announcements of large projects of other companies aiming at big-inch economics are expected soon.

Mid-Valley Pipe Line Co. is already under way with construction of its 1,000-mile, 20-22-in. Longview, Tex.-Lima, Ohio, line to be finished in 1950. Next year the fastest pipe-line construction ever attempted will be undertaken for the 1,150-mile, 16-18-20-in. Edmonton, Alta.-Superior, Wis., crude-oil line of Interprovincial Pipe Line Co. and Lakehead Pipe Line Co., Inc., which is to be completed in 5 months. Portland Pipe Line Co. will lay 236 miles of 22-in. looping.

Outstanding in products pipe lining is Great Lakes Pipe Line Co.'s $55,000,000 program now partially under way which will include laying nearly 1,450 miles of looping.

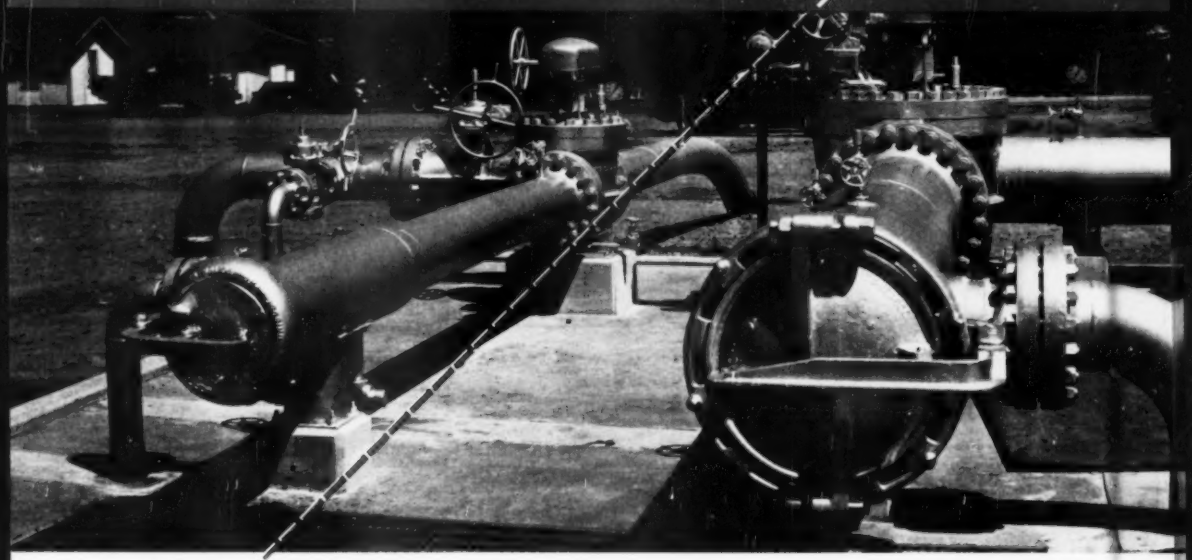
Middle East programs totaling approximately 5,400 miles of 16-34-in. lines for several companies are predominant in the foreign field.

At the 1949 construction rate of 15,000 miles annually, it would take nearly 3 years to complete projects now under way and planned for the future. Meanwhile additional large projects yet to be announced give promise of an active period of pipe lining in the future.

TABLE I—PRINCIPAL DOMESTIC CRUDE-OIL PIPE-LINE PROJECTS UNDER WAY AND PLANNED

Company—	Miles	Inch	Status	Contractor, location, and completion date
Arizona Pipe Line Co.	600	8	Proposed	Permian basin-Phoenix, Ariz.
Atlantic Pipe Line Co.	420	10	Under way	Evans & James—Crane to Harbor Island, Tex., 9-10-49.
Buckeye Pipe Line Co.	21	6	Under way	H. L. Gentry Const.—Lawrenceville-Robinson, Ill.
Continental Pipe Line Co.	25	6	Under way	Goldenstern & Stolper, Inc.—Wichita Falls, Tex., S.W. to Block 110, Abs. 384, W. M. Sellers Survey, Archer County, Texas, 9-20-49.
Cooperative Refinery Association	48	6	Authorized	Cowley County, Kansas.
Humble Pipe Line Co.	375	18	Authorized	Kemper sta., W. Tex. to Satsuma sta. in Houston area, 5-50.
Interstate Oil Pipe Line Co.	85	12	Under way	C. B. Edmonds Transportation Co.—Elk Basin to Billings, Mont.
Mid-Valley Pipe Line Co.* (Sun and Sohio)	1,053	20-22	Under way	Longview, Tex., to Mayersville, Miss.-Covington, Ky., to Lima, Ohio.
Mid-Valley Pipe Line Co.*	34	6-8	Under way	Latex Const.—Stephens, Ark., to Haynesville, La.
Mid-Valley Pipe Line Co.*	110	20	Authorized	Longview, Tex., to Haynesville, La.
Mid-Valley Pipe Line Co.*	41	12	Under way	Latex Const.—Vicinity of Delhi to Lake Providence, La., laterals.
Mid-Valley Pipe Line Co.*	120	20	Under way	Latex Const.—Haynesville, La., to Mississippi River, north of Lake Providence, La.
Mid-Valley Pipe Line Co.*	22	8	Under way	Latex Const.—Haynesville, La., to Stephens, Ark.
Mid-Valley Pipe Line Co.*	12	6	Under way	Latex Const.—Haynesville, La., to Stephens, Ark., laterals.
Mid-Valley Pipe Line Co.*	236	20	Under way	Latex Const.—Haynesville, La., to Mayersville, Miss.
Mid-Valley Pipe Line Co.*	573	22	Under way	Associated-Eastern-Britton—Gentry-Mayersville, Miss., to Hebron, Ky.
Mid-Valley Pipe Line Co.*	124	20	Under way	Britton Const.—Hebron, Ky., to Lima, Ohio.
Mid-Valley Pipe Line Co.*	43	12	Under way	Latex Const.—Delhi, La., to Mayersville, Miss.
Pan American Pipe Line Co.	16	6-8	Authorized	Quitman to Kilgore, Tex., loop.
Phillips Pipe Line Co.	25	8	Considered	Loops between Thrall, Kans., and Kansas City, Kans.
Phillips Pipe Line Co.	54	8	Under way	Bill Morrison-C. E. Wilson-Anderson Bros.—Thrall, Kans., and Kansas City, Kans., loops, 10-49.
Plains Pipe Line Co.	50	8	Under way	Mush Creek field to Lance Creek field, Wyoming, 9-49.
Portland Pipe Line Co. and Montreal Pipe Line Co., Ltd.	236	22	Planned	Portland, Me., to Montreal, Que., Canada.

UNIBOLT *Hinged* SCRAPER TRAPS



An Open and Shut Case

OF PIPELINE ECONOMY, SAFETY AND CONVENIENCE

Pipeliners, who for years have struggled with heavy, multi-bolt blind flange closures and leaky-thread bull plugs on scraper traps, will welcome this easy-operating UNIBOLT Scraper Trap. You just release two bolts, and s-w-i-n-g the trap cover, or blanking plug, out of the way. A simple hinge carries the load. It's compact, it eliminates heavy lifting, and there's nothing to fall on the workmen. Swing it shut, tighten two bolts, and the line is ready for business again! Many operators who installed UNIBOLT Scraper Traps before the hinge design was available are now converting to the new design by installing the hinges on the job. Available in sizes from 8" to 28".

Any line or unit that requires closures, such as strainers, separators, scrubbers, mist removers and similar pressure vessels, may be UNIBOLT-equipped to real advantage. Wherever a blind flange is applicable, a UNIBOLT Coupling with Blanking Plug will do the job better — seal tighter, reduce weight, and save time.

THORNHILL-CRAVER CO.

HOUSTON, TEXAS

STRAINER

GAS LINE SCRUBBER

PIPE LINE FILTER

GAS LINE BLOW-DOWN

TERMINAL MANIFOLD

TABLE 1—PRINCIPAL DOMESTIC CRUDE-OIL PIPE LINE PROJECTS UNDER WAY AND PLANNED (Continued)

Company—	Miles	Inch	Status	Contractor, location, and completion date
Roosevelt Oil & Refining Co. (Simrall Div.)	50	6	Under way	Somerville Const. Co.—Pentwater field, Oceana County, Michigan, south to Woodville in Newaygo County, Michigan.
Shell Pipe Line Corp.	33	12	Under way	Smith Contracting—Wasson sta., W. Tex., to Hobbs sta., N. M.
Shell Pipe Line Corp.	190	10	Under way	Trojan Const. Co.—Cushing, Okla., to Emmett, Mo., takeup, 12-31-49.
Shell Pipe Line Corp.	160	10	Under way	Trojan Const. Co.—Cushing, Okla., to Elk City, Okla., 12-31-49.
Skelly Oil Co.	73	8	Under way	Bishop & Lock Const.—Burrton, Kans., to El Dorado, Kans.
Socony-Vacuum Oil Co., Inc. (White Eagle Div.)	122	8	Considered	Big Horn basin to Casper, Wyo.
Standard Oil Co. of Calif.	10	10	Under way	Facific Pipe Line Engrs., Ltd.—Wilmington and Torrance.
Standard Oil Co. of Calif.	16	6 and 10	Authorized	Wilmington to Torrance; West Montalvo to San Buena Ventura, Calif.
Stanolind Pipe Line Co.	31	10-12	Under way	C. S. Foreman—Elmont and Blaine sta., Kans., loops.
Sun Pipe Line Co.	61	4-10	Authorized	Seabreeze to Sun sta., Texas.
Texas-Empire Pipe Line Co.	40	16	Authorized	Wilmington, Ill., to East Chicago, Ind.
Texas-New Mexico Pipe Line Co.	42	10	Authorized	Colorado City, Tex., to Borden County, Texas.
Texas-New Mexico Pipe Line Co.	35	10-6-4	Authorized	Borden and Howard counties, Texas.
Texas Pipe Line Co.	131	12	Under way	Smith Contr. Corp.—Chico to Corsicana, Tex., 10-49.
Texas Pipe Line Co.	187	12	Authorized	Wichita Falls to Corsicana, Tex.
Texas-Western Oil Lines, Inc.	1,000	20-24	Proposed	Midland-Odessa area, Texas, to Los Angeles, Calif.
Union Oil Co. of Calif.	20	8-10	Proposed	Miscellaneous crude and products.

*Mid-Valley Pipe Line Co.'s program of 1,164 miles of 20-22-in. trunk line now has contracted 1,053 miles of 20-22-in., and will contract 110 miles of 20-in. in 1950.

TABLE 2—PRINCIPAL DOMESTIC PRODUCTS PIPE LINES UNDER WAY AND PLANNED

Buckeye Pipe Line Co.	140	8	Under way	H. L. Gentry Const. Co.—Indianapolis to Lima, Ohio, 12-49.
Connecticut Pipe Line Co.*	40	8	Planned	New Haven to Hartford, Conn.
Great Lakes Pipe Line Co.†	1,298	12	Planned	Looping from Tulsa north.
Great Lakes Pipe Line Co.†	150	8	Planned	Looping.
Great Lakes Pipe Line Co.†	950	12	Authorized	Looping.
Great Lakes Pipe Line Co.†	65	12	Under way	O. R. Burden Const. Corp.—North from Des Moines.
Great Lakes Pipe Line Co.†	72	12	Under way	A. C. Holder Const. Co.—To Iowa-Minnesota state line.
Great Lakes Pipe Line Co.†	104	12	Under way	Sheehan Pipe Line Const. Co.—Albert Lea, Minn., to St. Paul.
Great Lakes Pipe Line Co.†	20	12	Under way	Williams Brothers Corp.—Mississippi River crossing and line to terminal and station.
Phillips Petroleum Co. and Shamrock Oil & Gas Co.*	152	6	Planned	La Junta, Colo., to Denver.
Salt Lake Pipe Line Co.	360	8	Planned	Salt Lake City to Pasco, Wash.
Salt Lake Pipe Line Co.	168	8	Under way	Smith Contr. Corp.—Salt Lake City to Burley, Idaho, 12-15-49.
Salt Lake Pipe Line Co.	152	8	Under way	Grafe-Callahan Const. Co.-Oklahoma Contr. Co.—Burley to Boise, Idaho, 12-15-49.
Salt Lake Pipe Line Co.	242	8-6	Planned	Boise, Idaho, to Pasco, Wash., 12-50.
Sinclair Refining Co.	700	8	Planned	Sinclair, Wyo., to Kansas City.
Socony-Vacuum Oil Co., Inc.	18	6	Considered	Christmans to Hazleton, Pa.
Standard Oil Co. (Ohio)	38	8	Authorized	Toledo to Fostoria, Ohio.
Tuscarora Oil Co., Ltd.	21	10	Under way	Pipe Line Const. & Drlg. Co.—East Waterford, Pa., West, 6-1-49.
Union Oil Co. of California	10	6	Planned	Torrance to Rosecrans.

*Deferred. †Great Lakes Pipe Line Co.'s program of 1,298 miles of 12-in. and 150 miles of 8-in. has 950 miles authorized and a total of 261 contracted.

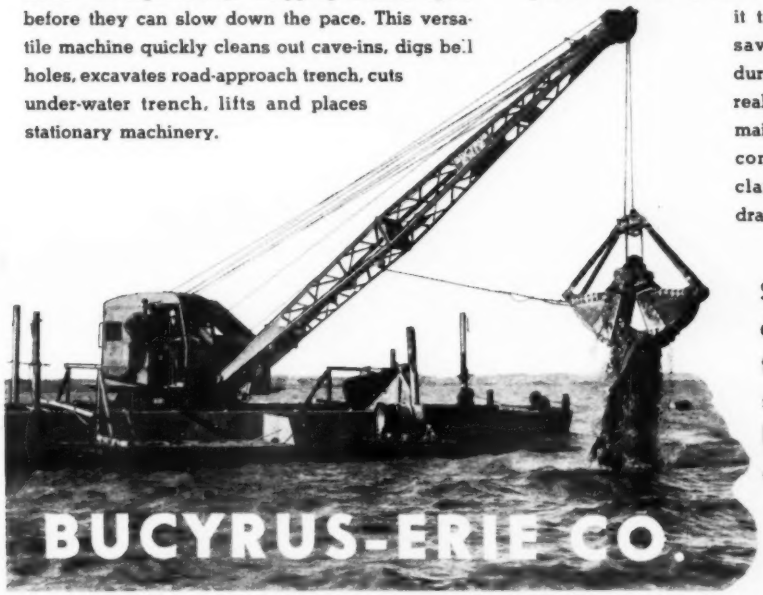
TABLE 3—PRINCIPAL DOMESTIC NATURAL-GAS PIPE-LINE PROJECTS UNDER WAY AND PLANNED

Alabama-Tennessee Natural Gas Co.	75	10	Planned	From Tenn. Gas Trans. Co. line near Selmer, Tenn., to Tuscombia, Ala.
Alabama-Tennessee Natural Gas Co.	61	6	Planned	Tuscombia to Huntsville, Ala.
Alabama-Tennessee Natural Gas Co.	80	11	Under way	Lehman-Hoge & Scott—Selmer, Tenn., to Muscle Shoals, Ala., 12-1-49.
Alabama-Tennessee Natural Gas Co.	36	6-8	Authorized	Muscle Shoals to Decatur, Ala.
Alabama-Tennessee Natural Gas Co.	25	6	Authorized	Decatur to Huntsville, Ala.
Arkansas Louisiana Gas Co.	162	20	Planned	Latex Const.-Anderson Bros.-Omaha Dredge & Dock Co.—Waskom, Tex., to Perla, Ark., 12-49.
Arkansas Louisiana Gas Co.	70	20	Under way	Anderson Bros.—Waskom, Tex., to Magnolia, Ark., 11-1-49.
Atlantic Gulf Gas Co. (United Gas Pipe Line Co.)	1,530		Planned	Alabama-Florida-Georgia-South Carolina.
Atlantic Seaboard Corp.	75	26	Under way	Ray L. Smith & Son, Inc.—Clendenin, W. Va., to N.E., 12-49.
Atlantic Seaboard Corp. and Virginia Gas Trans. Co.	68	26	Under way	H. C. Price Co.—Mouth of Seneca to Cleveland, W. Va.
Atlantic Seaboard Corp. and Virginia Gas Trans. Co.	70	26	Under way	H. C. Price Co.—Seneca, W. Va., to Strasburg, Va.
Atlantic Seaboard Corp. and Virginia Gas Trans. Co.	68	26	Under way	H. C. Price Co.—Strasburg, Va., to Rockville, Md.
Atlantic Seaboard Corp. and Virginia Gas Trans. Co.	268	26	Under way	H. C. Price, Ray L. Smith & Son—Clendenin, W. Va., to Rockville, Md.
Atomic Energy Commission (U. S. Govt.)	95	12	Under way	Morrison-Haddock Engr. Co.—Bloomfield to Los Alamos, N. M.
Cabot Carbon Co.	26	10	Planned	McVean & Roberts Pipe Line Const.—Odessa, Tex., 7-15-49.

More SPEED for Your Spread

The fast-moving, slick-working Bucyrus-Erie ¾-yd. 22-B excavator can play a decisive role in speeding up your pipe-line spread. It travels up and down the right-of-way, whipping trouble spots before they can slow down the pace. This versatile machine quickly cleans out cave-ins, digs bell holes, excavates road-approach trench, cuts under-water trench, lifts and places stationary machinery.

The 22-B's speedy operating cycle and smooth positive control mean quick handling of these and other jobs that can hold up the progress of the spread. Its mobility and sure-footed stability let it travel about with time-saving ease. Its simple durable construction means real dependability and low maintenance. It is quickly convertible for use as clamshell, crane, shovel, dragline, or dragshovel.



See your Bucyrus-Erie distributor for full details on how you can speed up your pipe-line operations with a 22-B!

BUCYRUS-ERIE CO.

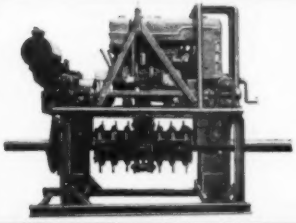
SOUTH MILWAUKEE, WISCONSIN

172E49

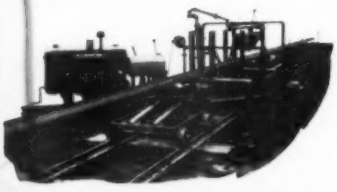
Pipeline EQUIPMENT, SUPPLIES AND MATERIALS . . .

[illegible] COATING & WRAPPING MACHINE — These machines are made to coat and wrap pipe sizes from 2" to 34" in diameter. Because of the positive application of coating through our patented coating spray shoe, we can assure the pipeline owner a better coating job and the pipeline contractor better production and lower cost. This machine assures you of a uniform coating, even though the pipe is [illegible] or "egged".

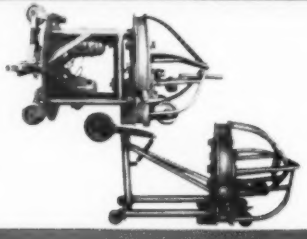
MODEL "K" PIPE CLEANING & PRIMING MACHINE — can be set up to clean and prime pipe from 16" to 34" in diameter. May be used line traveling or on stationary base.



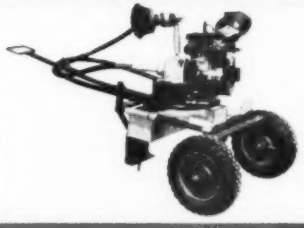
MODEL "M" PIPE CLEANING & PRIMING MACHINE — can be set up to clean and prime pipe from 2" to 16" in diameter. May be used as a traveling machine or on a stationary base for yard work.



STATIONARY COATING MACHINE—Available for coating and wrapping pipe sizes from 2" to 36". This machine will apply any specification, that is single coat and single wrap, single coat and double wrap or double coat and double wrap.

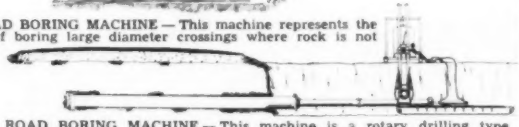


CROSE INTERNAL LINEUP CLAMPS — Available in both manual and electric models for pipe sizes ranging from 12" to 36". Crose Internal Lineup Clamps have now been used on well over 15,000 miles of large diameter piper.

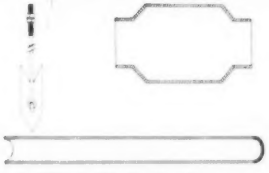


CROSE PORTABLE BUFFING UNIT — This machine may be used to operate sanding discs or wire wheels for cleaning stringer beads or pipe bevels.

CROSE AUGER TYPE ROAD BORING MACHINE — This machine represents the fastest and simplest way of boring large diameter crossings where rock is not encountered.

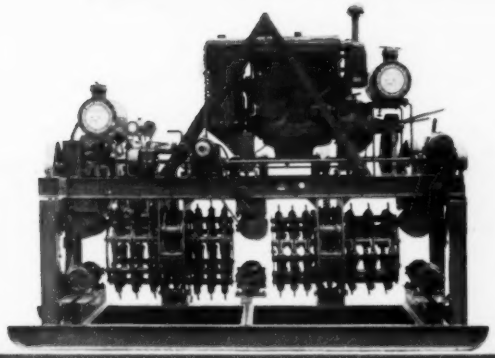


YOUNG ROAD BORING MACHINE — This machine is a rotary drilling type machine. It has proven saitsfactory in some rock formations.



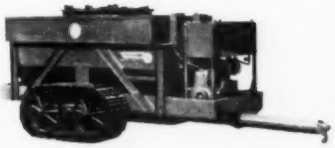
CROSE PIPE LINE ANCHORS, HALF SOLES AND WELDING SLEEVES — Crose Pipe Line Anchors represent the cheapest method of restraining large diameter pipe where swamp or flood conditions are encountered. Crose Half Soles and Welding Sleeves can be furnished to your specifications.

CROSE PIPE CUTTING & BEVELING MACHINE — for fast true cutting and beveling of pipe. Available in six sizes for 4 to 36" pipe. Machines for 16" pipe and above have "Out of Round" Attachment as standard part. Aluminum alloy construction.

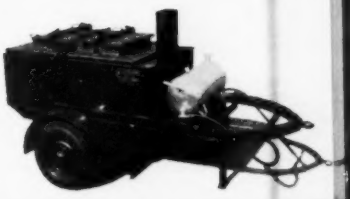


CROSE MODEL "MX" F-16" STATIONARY PIPE CLEANING & PRIMING MACHINE.—This machine was especially designed for cleaning or reconditioning used pipe. The machine is equipped with twice as many rows of cleaning tools (Knives, Cutters or Brushes) as any conventional machine. This machine already in use has doubled production.

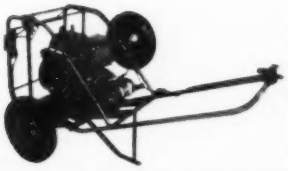
CROSE PIPE CRADLES — We manufacture cradles to handle pipe sizes from 4" to 24" in diameter. Cradle illustrated can be adjusted to cradle pipe from 16" to 28" in diameter.



[illegible] COATING KETTLE—There are now [illegible] these units in operation. The first one of these units we ever sold has now been used on well over 250 miles of Big Inch Pipe and maintenance charges during that time have amounted to less than $400.00. Due to the patented agitator and burner arrangement, no coking is experienced with these kettles. Further, it has never been necessary to re-[illegible]



5 BARRELL PATCH KETTLE — This unit is equipped with a manual agitator and is ideal for patch work or maintenance work.



1500 WATT SELF PROPELLED GENERATOR — Utility unit for operating wire brushes, buffers and cleaning bevels. May be used as utility light plant.

CROSE PIPE EXPANDERS — Available in sizes from 16" to 36". Places "egged" pipe in perfect round so that true bevels may be cut and proper lineups can be made.

PIPE WRAPPING MATERIALS — VITRON Glass Fiber Underground Pipe Wrap will be used on 5,000 miles of pipeline this year. VITRON Glass Fiber Underground Pipe Wrap, Asbestos Felt and Kraft Paper are all available for immediate shipment from warehouse stock at Tulsa, Oklahoma or Houston, Tex.

M. J. CROSE MANUFACTURING CO., INC.

2715 DAWSON ROAD • TULSA, OKLAHOMA • PHONE 6-2173

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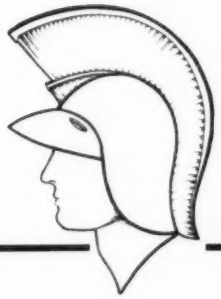
TABLE 3—PRINCIPAL DOMESTIC NATURAL-GAS PIPE-LINE PROJECTS UNDER WAY AND PLANNED (Continued)

Company—	Miles	Inch	Status	Contractor, location, and completion date
Carthage Hydrocol, Inc.	63	12-16	Under way	H. B. Zachry Co.—San Salvador area to Carthage synthetic gasoline plant at Brownsville, Tex.
Central Kentucky Natural Gas Co.	38	12-20	Planned	Kentucky loops, 1949.
Chicago District Pipe Line Co.	41	24	Authorized	Loop Calumet Pipe Line—Joliet, Ill., to Chicago, 12-50.
Cities Service Gas Co.	131	26	Under way	R. H. Fulton & Co.—Sperling to Ottawa, Kans., 9-15-49.
City of Indianapolis, Inc.	55	16	Proposed	Indianapolis to Texas Eastern Transmission Corp. system.
Coast Counties Gas & Electric Co.	40	3-4-8	Considered	Coast and valley region, California.
Coastal Pipe Line Co.	1,000		Planned	Texas to Norfolk, Va.
Colorado Interstate Gas Co.	38	20	Planned	Texas Panhandle and Hugoton field, Kansas, to Denver, looping.
Colorado Interstate Gas Co.	15	20	Planned	R. H. Fulton & Co.—Lakin, Kans.
Colorado-Wyoming Gas Co.	41		Planned	Greeley, LaSalle, and Windsor, Colo., areas.
Columbia Gas System, Inc.	38	20-16	Under way	Mahoney Contr. Co.—Fairfield County to Columbus, Ohio, 11-15-49.
Columbia Gas System, Inc.	8	16	Under way	Harry Strodtbeck—Greene County to Clarke County, Ohio, 9-20-49.
Columbia Gas System, Inc.	10	16-12	Under way	Harford Bros.—Huron County, Ohio, 9-15-49.
Columbia Gas System, Inc.	11	16	Under way	H. L. Gentry—Richland County, Ohio, 11-15-49.
Columbia Gas System, Inc.	23	12	Under way	Williams-Austin Co.—Menifee County to Clark County, Kentucky, 1949.
Columbia Gas System, Inc.	7	16	Under way	Britton Contr. Co.—Hickory to Commonsburg, Pa., 1949.
Columbia Gas System, Inc.	49	10-8	Under way	Williams Bros.—Port Jervis, N. Y., to West Nyack, 11-1-49.
Consolidated Gas Utilities Corp.	14	12	Authorized	Elk City field to existing line near Carpenter, Okla., 11-1-49.
Consolidated Gas Utilities Corp.	41	12	Planned	Enid to Blackwell, Okla., Marlow to Cement, Okla.
Continental Oil Co.	35	2-20	Under way	George Tucker Pipe Line Const.—Big Lake, Tex., 9-1-49.
East Tennessee Natural Gas Co.	172	22	Under way	Oman Const.—Greenbrier to Oak Ridge, Tenn., 12-49.
East Tennessee Natural Gas Co.	185	16	Planned	Walters & Saigh Const.—Labelville to Chattanooga, Tenn.
East Tennessee Natural Gas Co.	120	12¾	Planned	Walters & Saigh Const.—Chattanooga to Knoxville, Tenn.
East Tennessee Natural Gas Co.	150	16	Planned	Knoxville to Bristol, Tenn.
Egyptian Natural Gas Co.	80	6-8	Planned	Norris City to Salem-Centralia, Ill., areas.
East Tennessee Natural Gas Co.	398	3-16	Planned	Nashville-Chattanooga-Knoxville, Tenn., and later lines.
El Paso Natural Gas Co.	105	24	Authorized	Company crews—Upton County, Texas-Jal, N. M., 10-49.
El Paso Natural Gas Co.	102	26	Authorized	Company crews—Crossover south to Topock, Ariz.
El Paso Natural Gas Co.	450	30	Under way	Company crews—Eunice, N. M.-Blythe, Calif., looping, 1951.
El Paso Natural Gas Co.	451	24	Planned	Farmington, N. M. (San Juan basin)-Topock, Ariz., 1951.
El Paso Natural Gas Co.	270		Planned	Laterals for San Juan project.
El Paso Natural Gas Co.	130	6-8-10	Under way	Company crews—Wilcox-Globe, Ariz.
Gulf Oil Corp.	40	3-24	Under way	Younger Const. Co.—Eunice, N. M., gathering system and gasoline plant.
Gulfcoast Northern Gas Co.	1,184	26	Proposed	Corpus Christi, Tex., area to Illinois.
Home Gas Co.	70		Planned	Orange, Sullivan-Rockland counties, New York-Cattaragus County, New York, areas.
Hope Natural Gas Co.	32	16	Under way	Pipe Line Const. & Drlg. Co.—Hasting to Clarksburg, W. Va., 8-1-49.
Houston Pipe Line Co.	10	12	Authorized	Houston to San Jacinto field, Texas, fall.
Houston Pipe Line Co.	67		Under way	Latex—Village Mill, Tex., area.
Interstate Natural Gas Co.	29	22-20-16	Under way	Latex Const. Co.—West of Baton Rouge, La.
Iroquois Gas Corp.	13	22	Planned	Loops, New York State.
Jersey Central Power & Light Co.	39	10	Planned	New Jersey to Coast System of Texas Eastern Transmission Co.'s Big Inch.
Kansas-Nebraska Natural Gas Co., Inc.	10	12¾	Under way	Rumsey Bros. P. L. Const.—Replace 8-in. Alma-Holdredge, Neb., line.
Kansas-Nebraska Natural Gas Co., Inc.	51	14	Under way	Rumsey Bros. P. L. Const.—Elm Creek to Loup City, Neb.
Kansas-Nebraska Natural Gas Co., Inc.	36	8	Under way	Rumsey Bros. P. L. Const.—Litchfield to Broken Bow, Neb.
Kansas-Nebraska Natural Gas Co., Inc.	10	6	Under way	Rumsey Bros. P. L. Const.—Red Cloud to Guide Rock, Neb.
Kansas-Nebraska Natural Gas Co., Inc.	210		Planned	Kansas-Nebraska area.
Kansas Light & Power Co.	146	20-22	Under way	M. J. White—Ulysses to Pratt, Kans.
Lavaca Pipe Line Co.	18	6	Authorized	Continental Const.—Pt. Comfort to Francitas, Tex., wrought-iron line.
Lone Star Gas Co.	27	10	Under way	Company crews—Pottsville field, Texas.
Lone Star Gas Co.	101	8	Under way	Company crews—Pottsville field, Texas.
Lone Star Gas Co.	54	6	Under way	Company crews—Pottsville field, Texas.
Lone Star Gas Co.	25	4	Under way	Company crews—Pottsville field, Texas.
Lone Star Gas Co.	25	20	Under way	Company crews—East of Dallas to west of Irving, Tex.
Manufacturers Light & Heat Co.	86	6-12	Under way	Williams Bros.—Port Jervis-Nyack, N. Y.
Mesabi Pipe Line Co.	400	18	Proposed	Keokuk, Iowa-Itasca, Minn.
McCarty Oil & Gas Co.	100	12-13-16-20	Under way	Anderson Bros.—Jackson Pasture to Orange, Tex.
Michigan Gas Storage Co.	113	20	Under way	Mahoney Contr. Co.—Laying 61-mi. Freedonia-Laingsburg-Lansing, Mich.
Michigan Gas Storage Co.	150	20	Planned	Mahoney Contr. Co.—Chelsea Terminal-Winterfield and Cranberry Lake, Mich.
Michigan-Wisconsin Gas Co.	100	10	Under way	Anderson Bros.—Wisconsin, 10-15-49.
Michigan-Wisconsin Pipe Line Co.	341	24	Under way	J. R. Horrigan Const.—Maryville, Mo., to Sandwich, Ill., 12-49.



GENERAL PIPE LINE CONTRACTORS

OF PIPE LINES - WATER LINES
SEWER LINES - EXCAVATIONS
SALT WATER DISPOSALS

Personal Supervision

We know that in addition to having experienced personnel and ample equipment, it takes *personal supervision* to get the job done *right*. That's why one of these four men: Albert C. Johnson, Charles T. Tillotson, Maurice W. Crawford or Felix M. Johnson, personally supervises each and every one of our construction projects.

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TABLE 3—PRINCIPAL DOMESTIC NATURAL-GAS PIPE-LINE PROJECTS UNDER WAY AND PLANNED (Continued)

Company—	Miles	Inch	Status	Contractor, location, and completion date
Michigan-Wisconsin Pipe Line Co.	106	22	Under way	J. R. Horrigan Const.—Sandwich, Ill., to Milwaukee, 12-49.
Michigan-Wisconsin Pipe Line Co.	256	22	Under way	J. R. Horrigan Const.—Sandwich, Ill., to Big Rapids, Wis., 12-49.
Michigan-Wisconsin Pipe Line Co.	39	4-3-2	Under way	Rumsey Bros. Const.—Fort Madison to Mount Pleasant, Iowa, 12-49.
Michigan-Wisconsin Pipe Line Co.	97	22-10	Under way	Anderson Bros.—Racine to Stoughton, Wis., 12-49.
Michigan-Wisconsin Pipe Line Co.	188	4-14	Authorized	Wisconsin, 7-1-50.
Michigan-Wisconsin Pipe Line Co.°	170	24	Under way	J. R. Horrigan—Sandwich Jct., Ill.-Mount Pleasant, Iowa.
Michigan-Wisconsin Pipe Line Co.°	188	22	Under way	J. R. Horrigan—Milwaukee-Burlington, Wis.
Michigan-Wisconsin Pipe Line Co.°	180	22	Under way	Oklahoma Contr.—Big Rapids, Mich.-Crown Point, Ind.
Mississippi River Fuel Corp.	224	24	Under way	R. B. Potashnick—Looping from Perryville, 11-15-49.
Mississippi River Fuel Corp.	10	20-24	Under way	Sheehan Pipe Line Const. Co.—Granite City to E. St. Louis, Ill.
Montana-Dakota Utilities Co.	30	4	Authorized	Saco and Baker, Mont.
Montana-Dakota Utilities Co.	60	3-12	Authorized	Field lines for 1949 construction.
Mountain Fuel Supply Co.	32	20	Under way	Enoch Smith Sons Co.—Salt Lake City to Coalville, Utah, 10-1-49.
Natural Gas Pipeline Co. of America	27	26	Under way	Midwestern Const.—Main-line looping, Iowa and Illinois.
Northern Natural Gas Co.	41	20	Under way	R. H. Fulton & Co.—S.W. Garden City, Kans., 12-49.
Northern Natural Gas Co.	62	20-24	Planned	R. H. Fulton & Co.—Garden City, Kans.
Northern Natural Gas Co.	58	4-24	Authorized	Hugoton and Panhandle fields.
Northern Natural Gas Co.	135	20-24	Under way	C. G. Griffis Const.-Eastern Const.—Iowa, Minnesota, Kansas, Nebraska.
Northern Natural Gas Co.	88		Planned	Kansas-Nebraska looping.
Northwest Natural Gas Co.	750		Planned	Washington, Oregon, and Idaho.
Ohio Fuel Gas Co.	36	16-20	Under way	Mahoney Contr. Co.—Sugar Grove and New Albany, Ohio, 11-15-49.
Ohio Fuel Gas Co.	86	20	Under way	Midwestern, Anderson Bros.—Crawford-Lick station, Ohio; Lick-South Point stations, Ohio.
Ohio Fuel Gas Co.	48	20	Under way	Mahoney—Mount Gilead to Treat station; Pavonia station to Washington, Ohio.
Ohio Fuel Gas Co.	8	18	Under way	Anderson Bros.—Centerville, Ohio, to Station 16, Texas Eastern.
Ohio Fuel Gas Co.	85		Planned	Central Ohio replacement.
Ohio Fuel Gas Co.	12	16	Under way	H. L. Gentry Const.—Pavonia station to Weaver station, Ohio.
Ohio Fuel Gas Co.	11	16	Under way	H. L. Gentry Const.—Pavonia to Mansfield, Ohio, 11-49.
Ohio Fuel Gas Co.	11	16	Under way	Mahoney Contr.—Sugar Grove to Carroll, Ohio, 11-49.
Oklahoma Nat. Gas Co.	65	13	Under way	Trojan Const.—Chickasha to Stroud, Okla.
Oklahoma Nat. Gas Co.	22	11	Authorized	Guthrie to Stillwater, Okla., 11-49.
Pacific Gas & Electric Co.	47	8	Authorized	Salinas to Kilig City, Calif.
Pacific Gas & Electric Co.	506	34	Under way	Bechtel-Price-Conyes Corp.—Topock, Ariz., to Milpitas, Calif.
Pacific Lighting Corp.	17	20	Under way	Signal Pipe Line Const. Co.—Encino to Thousand Oaks, Calif., 11-49.
Pacific Lighting Corp.	15	30	Under way	Alex Robertson Co.—Rivera to Inglewood, Calif., 11-49.
Pacific Lighting Corp.	35	16	Under way	J. E. Young Co.—Moreno to Rainbow, Calif., 12-49.
Pacific Lighting Corp.	41	30	Planned	Puente to March field, California, 1950.
Pacific Lighting Corp.	23	30	Planned	Inglewood to Encino, Calif.
Panhandle Eastern Pipe Line Co.	50	26	Under way	Anderson Bros.—Illinois-Indiana and Missouri, 10-15-49.
Panhandle Eastern Pipe Line Co.	23	26	Under way	Anderson Bros.—Missouri, looping, 10-49.
Panhandle Eastern Pipe Line Co.	15	26	Under way	C. S. Foreman & Co.—Missouri, looping, 10-49.
Panhandle Eastern Pipe Line Co.	10	26	Under way	R. H. Fulton & Co.—Oklahoma, looping, 10-49.
Panhandle Eastern Pipe Line Co.	356	26	Authorized	Looping in Texas, Oklahoma, Kansas, Missouri, Illinois, Indiana, Ohio, and Michigan.
Panhandle Eastern Pipe Line Co.	85	24-26	Under way	R. H. Fulton & Co.—Loops near Liberal, Kans.
Panhandle Eastern Pipe Line Co.	132	26	Under way	R. H. Fulton & Co.-C. S. Foreman & Co.-Anderson Bros.—Kans., Mo., Ill., Ind., and Ohio, fall 1949.
Panhandle Eastern Pipe Line Co.	252	26	Authorized	Loops from Texas and Michigan.
Peoples Natural Gas Co.	38	14	Under way	Williams-Austin Co.—Rockwood to Johnstown, Pa., 10-49.
Piedmont Natural Gas Corp.	1,290	20	Planned	Upper Gulf Coast area to Danville, Va.
Potomac Gas Co.	18	16	Planned	Dranesville to Arlington, Va.
San Diego Gas & Electric Co.	53	16	Planned	San Diego County, California, 12-1-49.
San Diego Gas & Electric Co. (Southern Counties Gas Co.)	85		Authorized	San Diego-Riverside-Moreno, Calif.
Southern California Gas Co.	13	30	Under way	Alex Robertson-Rivera to Pasadena, Calif., 12-1-49.
Southern Counties Gas Co.	88	30	Planned	Whitewater to Rosemead, Calif., 12-1-49.
Southern Counties Gas Co.	17	30	Planned	Rivera to Southwest Los Angeles, Calif., 12-1-49.
Southern Natural Gas Co.	138	20-22	Planned	Chattanooga, Tenn., to Lexington, Miss.
Southern Natural Gas Co.	375	24	Planned	Gwinville, Miss., to Atlanta.
Southern Natural Gas Co.	225	16	Planned	Colfax, Ga., extension.
Southern Natural Gas Co.	61	24	Under way	Latex—Eastern Alabama loop.
Southern Natural Gas Co.	110	11	Considered	Extension.
Southern Natural Gas Co.	32	13	Under way	Ford, Bacon & Davis Const.—Branch line loop in Alabama, 11-20-49.
Southern Natural Gas Co.	314	18	Planned	Extension.
Southern Natural Gas Co.	171	16	Planned	Extension.
Southern Natural Gas Co.	118	13	Planned	Extension.
Southern Union Gas Co.	32	10-12-14	Under way	R. H. Fulton, H. B. Zachry, J. W. Walton—Albuquerque, Santa Fe, Roswell, N. M., loops.
Southern Union Gas Co.	78	8-10-14	Planned	New Mexico loops and laterals.
Tennessee Gas Transmission Co.	155	30	Authorized	Central Louisiana to northern Tennessee, looping.
Tennessee Gas Transmission Co.	200	30-24	Under way	Morrison Const. Co.-H. C. Price—Looping from Hemphill, Tex., to Monroe, La.

ONLY W.K.M. Valves have a round, full opening passage with the same I. D. as the pipe. This design eliminates turbulence and permits free passage of scrapers.

ONLY W.K.M. Valves seal off completely on both sides every time.

It is significant that most of the World's *big* pipelines are tied together with W.K.M. Valves. The superior performance that led to their use on these jobs will lead you to specify them for your next job when you investigate their exclusive design and operating advantages.

W-K-M Company, Inc.

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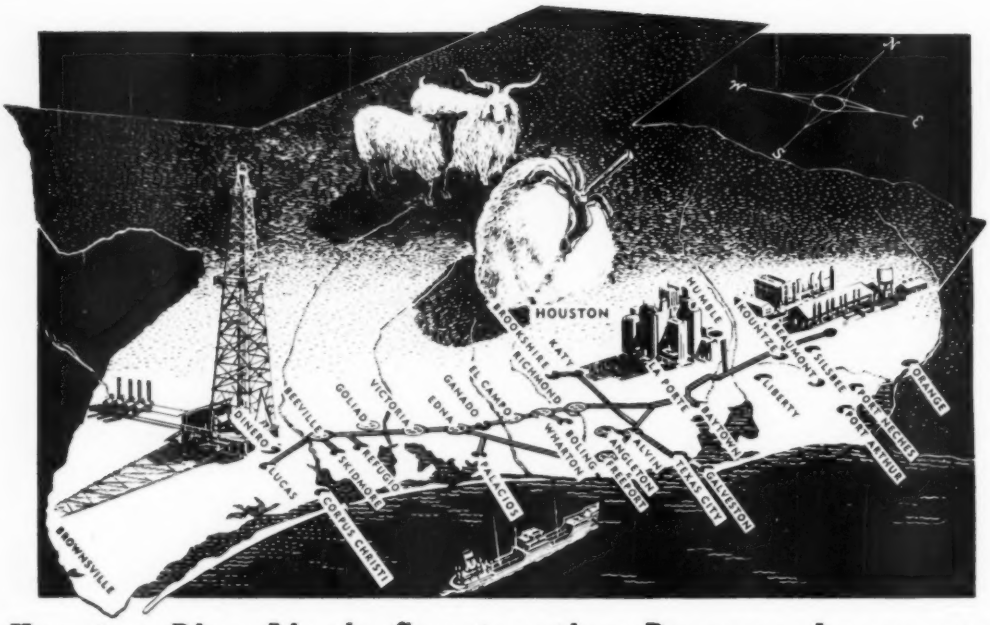

Houston Pipe Line's Construction Program keeps pace with the expanding economy of the Texas Gulf Coast

Houston Pipe Line Company announces an expansion of its system of natural gas pipe lines to enlarge the service it renders to the expanding industry of the Texas Gulf Coast. Now the system supplies natural gas to Texas homes and industries from the Big Thicket to the Nueces.

The Texas Gulf Coast is industry's new Golconda, an industrial El Dorado, the Gold Coast for those industries seeking the good fortune that derives from a combination of raw materials, efficient fuel, climate, and accessible markets. The Coast Country's fame is nation-wide; mention *Texas* to American industrial management, and association with *Houston, Galveston, Corpus Christi, Beaumont, Orange, Port Arthur* — and all the towns between—is immediate. Industry *knows* about the opportunity that awaits it on the Texas Coast; industry *plans* to make today's amazing industrial development greater still.

From the beginning, Houston Pipe Line Company has been privileged to cooperate with other Texas companies and communities in the industrial development of the Texas Coast Country. This year the Company begins its fourteenth consecutive year of *national advertising* of the Coast Country's industrial opportunities. Through its Research Department, the Company has supplied innumerable companies of many industries with detailed information about the Coast Country's advantages, and it has given new industries important assistance in the location of their plants on Texas' fabulous coast.

But the Company's chief contribution to Texas' industrial expansion has been to supply it with *natural gas*, industry's most efficient and economical fuel, and raw material for many of the processes in the Coast Country's great chemical development.

In 1949, the Company will be better equipped than ever before to render this essential service to Texas industry. The construction and recent completion of approximately 100 miles of main pipe lines to its gas fields in East Texas have increased its ability to keep pace with the expanding economy of the Texas Gulf Coast.

HOUSTON PIPE LINE CO.

Subsidiary of Houston Oil Company of Texas — GEO. A. HILL, JR., President

Wholesalers of **Natural GAS**

TABLE 3—PRINCIPAL DOMESTIC NATURAL-GAS PIPE-LINE PROJECTS UNDER WAY AND PLANNED (Continued)

Company—	Miles	Inch		Contractor, location, and completion date
Tennessee Gas Transmission Co.	54	30	Under way	Morrison Const. Co.—Harris and San Jacinto counties, 8-31-49.
Tennessee Gas Transmission Co.	30	30	Under way	Morrison—Sabine River-Pineland, Tex.
Tennessee Gas Transmission Co.	62	24-30	Under way	H. C. Price—Refugio to Victoria, Tex., 8-1-49.
Tennessee Gas Transmission Co.	65	16	Planned	Ohio-Pittsburgh spur.
Tennessee Gas Transmission Co.	790	20-26	Planned	Burnaugh, Ky., to Boston, including 395-mile line to Buffalo.
Tennessee Gas Transmission Co.	992	30	Planned	First 150 miles of loops to be laid at Monroe, La.; Greenville, Miss.; Midland and Portland, Tenn.
Tennessee Gas Transmission Co.	47	30	Authorized	Louisiana.
Tennessee Gas Transmission Co.	58	30	Authorized	Mississippi.
Tennessee Gas Transmission Co.	45	30	Authorized	Tennessee.
Tennessee Gas Transmission Co.	80	26-30	Under way	Anderson Bros.—Kentucky.
Tennessee Gas Transmission Co.	33	30	Under way	Company crews—Near Holly Springs, Miss., to Miss.-Tenn. state line.
Texas Eastern Transmission Corp.	56	26	Under way	Williams Bros.—Roseville to Woodfield, Ohio, 11-49.
Texas Eastern Transmission Corp.	37	20	Under way	Associated Pipe Line—Castor to Sharon, La., 11-49.
Texas Eastern Transmission Corp.	108	16	Authorized	Provident City to Baytown, Tex.
Texas Eastern Transmission Corp.	33	20	Authorized	Hankamer to Beaumont, Tex.
Texas Eastern Transmission Corp.	36	22	Under way	Associated Pipe Line Contr.—Near Lisbon, La., 11-49.
Texas Eastern Transmission Corp.	122	26	Under way	Associated Pipe Line Contr.—Lebanon to Somerset, Ohio, 11-49.
Texas Eastern Transmission Corp.	18	8	Authorized	Silsbee and Hastings, Tex., areas.
Texas Eastern Transmission Corp.	1,400	26	Planned	Texas to Pittsburgh, loops.
Texas Eastern Transmission Corp.	69	20	Planned	Looping in Beaumont, Tex., and Castor to Lisbon, La., areas.
Texas Eastern Transmission Corp.	100	16	Planned	Provident City field to Lavaca County to Baytown, Tex.
Texas Gas Transmission Corp.†	101	26	Under way	Latex Const. Co.—Sharon, La., to Lake Village, Ark., N.E.
Texas Gas Transmission Corp.†	80	26	Under way	Midwestern Constr., Inc.—Madison, Ind., to Warren County, Ohio, 12-31-49.
Texas Gas Transmission Corp.†	723	26	Under way	Lisbon, La., to Middletown, Ohio.
Texas Gas Transmission Corp.	110	26	Under way	J. R. Horrigan Const. Co.—Memphis, Tenn., to Fullerton, Ky.
Texas Gas Transmission Corp.	166	26	Under way	Williams Bros. Corp.—Kentucky to Ohio River.
Texas Gas Transmission Corp.†	110	20	Under way	N. A. Saigh—Carthage, Tex., to Lisbon, La.
Texas Gas Transmission Corp.†	32		Planned	Madisonville to Evansville, Ind.
Texas Illinois Natural Gas Pipeline Co.	1,000	30	Planned	Houston to Joliet, Ill.
Transcontinental Gas Pipe Line Co.‡	605	30	Under way	Morrison Bros. Const., Wunderlich & Griffis Const. Co., Midwestern Constructors, Inc.-Williams Bros. Corp.—Texas to New York.
Transcontinental Gas Pipe Line Co.‡	1,840		Under way	Main line 70 mi., 20-in.; 460 mi., 26-in.; 1,210 mi., 30-in.; Rio Grande Valley, Texas, to New York City.
Transcontinental Gas Pipe Line Co.‡	380	8-16	Planned	Laterals to gas field.
Transcontinental Gas Pipe Line Co.	216	30	Under way	Midwestern Constructors, Inc.—Demopolis, Ala., to Newnan, Ga., 12-49.
United Fuel Gas Co.	32	20	Authorized	Roane, Calhoun, and Wetzel counties, West Virginia.
United Gas Pipe Line Co.	80	2-4-6	Under way	L. E. Farley Const Co.—Laterals, North Mississippi.
United Natural Gas Co.	22	22	Authorized	Replacing 12-in. line Elk County, Pennsylvania.
United Natural Gas Co.	29	12	Authorized	Laterals, Elk County, Pennsylvania.
United Natural Gas Co.	14	12	Under way	Northeastern Const.—Pew comp. sta. in Clarion County, Pennsylvania, to Eldred comp. sta., Jefferson County, Pennsylvania.
Washington Light Co.	30	6-12	Under way	Britton Contr.—Washington, Pa.
West Texas Gas Co.	14	8	Under way	Western Construction Co.—Goldsmith to Odessa, Tex., 9-15-49.
West Texas Gas Co.	11	6	Authorized	Near Seagraves, Tex.

*Michigan-Wisconsin Pipe Line Co. is laying 530 miles of 22 and 24-in. in 1949 contracted by J. R. Horrigan Construction Co. and Oklahoma Contracting Co. for the company's 1,548-mile Hansford County, Texas-Big Rapids, Mich., project scheduled for completion July 1, 1950. †Texas Gas Transmission Corp. started laying its 833-mile, 26-in. line last year. Work of completing the project entails laying 723 miles in 1949 by Latex, O. C. Whitaker, J. B. Horrigan, Williams Brothers, and Midwestern. ‡Transcontinental Gas Pipe Line Co. is laying 605 miles of 30-in. in 1949 contracted by Morrison Brothers Construction Co., Wunderlich & Griffis Construction Co., Midwestern Constructors, Inc., and Williams Brothers Corp. This work is the beginning of Transcontinental's 2,200-mile Mercedes, Tex.-New York City project which will include 1,840 miles of trunk line and 380 miles of laterals.

TABLE 4—COMPLETED DOMESTIC CRUDE-OIL PIPE-LINE PROJECTS

Atlantic Pipe Line Co.	35	4-10	McVean & Roberts Pipe Line Const.—Gathering system near Crane, Tex.
Thomas S. Bryan Associated	10	4	Latex Const.—Near Opelousas, La.
Buckeye Pipe Line Co.	82	22	Anderson Bros.—Lima to Toledo, Ohio, 7-49.
Cities Service Pipe Line Co.	14		Gathering lines in Kansas, Oklahoma, and Texas.
Continental Pipe Line Co.	25	8	Knupp Constr. Co., Inc.—Claflin to Geneseo, Kans. Recondition, 10-1-49.
Interstate Oil Pipe Line Co.	22	8-12	O. C. Whitaker—Panther Creek Junction to Oklahoma City-Foster to Elmore City, Okla.
Interstate Oil Pipe Line Co.	10	8	Latex Const.—LaRose to Delta Farms, La.
Kaw Pipe Line Co.	15	10	Rumsey Bros.—Rempe to Bemis, Kans.
Lion Oil Co.	11	2-3-4	Ouachita to Smackover-El Dorado, Ark.
Magnolia Pipe Line Co.	14	8	C. L. Rogers Const. Co.—Crossroads, N. M., to Stanolind Pipe Line Co.'s Caprock-Mallett line, 9-49.
Magnolia Pipe Line Co.	26	8	C. L. Rogers Const.—Tatan, 7-49.
Magnolia Pipe Line Co.	70	3-4-6-8	C. L. Rogers Const. Co.—Gathering System, Howard and Scurry counties, Texas.
Mid-Valley Pipe Line Co.	43	12	Latex Const.—Delhi, La., to Mayersville, Miss.
Mid-Valley Pipe Line Co.	124	20	Britton—Hebron, Ky., to Lima, Ohio.
Pasotex Pipe Line Co.	22	6	Morrison & Co.—Sec. 441, Blk. 97, H&TC RR Co., Scurry County, N. Snyder field to Basin P. L. System, Colorado City Station Scurry County, Texas, 6-8-49.
Phillips Pipe Line Co.	44	8	Bill Morrison Const. Co.—Wichita, Kans., to Kansas City, Mo., loops, 6-25-49.
Phillips Pipe Line Co.	289	12	Morrison Bros.—Odessa to Borger, Tex., 5-49.

CRUTCHER-ROLFS-CUMMINGS, INC.

HOUSTON-TULSA

TABLE 4—COMPLETED DOMESTIC CRUDE-OIL PIPE-LINE PROJECTS (Continued)

Company—	Miles	Inch	Contractor, location, and completion date
Roosevelt Oil & Ref. Corp.	10	44	R. B. Somerville—Pentwater to Woodville, Mich., 8-10.
Roosevelt Oil & Ref. Corp.	30	6	R. B. Somerville—Pentwater to Woodville, Mich., 8-10.
Shell Pipe Line Corp.	41	14	Latex Const.—Eunice, N. M.
Shell Pipe Line Corp. (Ozark)*	435	22	Midwestern, Smith Contracting, Anderson Bros.—Cushing, Okla., to Wood River, Ill., 7-49.
Shell Pipe Line Corp.	40	14	Latex Const. Co.—Hobbs and Jal, N. M., 7-1-49.
Shell Pipe Line Corp.	29	12	Smith Contr.—Wasson, Tex., to Hobbs, N. M., 4-49.
Sinclair Refining Co.	90	2-8	Bill Morrison Const. Co.—Wewoka to Pauls Valley, Okla., 4-25-49.
Sinclair Refining Co.	20	3-8	Bill Morrison Const. Co.—Madison, Kans., North, 5-25-49.
Socony-Vacuum Oil Co., Inc., (White Eagle Division)	14	4	Pacific Pipe Line & Engr., Ltd.—Gooseberry Field, Park County, Wyoming, to Ohio Pipe Line Co.'s pump station, Hot Springs County, Wyo., 9-15-49.
Stanolind Pipe Line Co.	31	10	C. S. Foreman Co.—Washington, Kansas, to Freeman, Mo., 4-49.
Stanolind Pipe Line Co.	11	6	I. C. Little Const.—Jack County, Tex.-Extension to Post Oak area, 9-49.
Stanolind Pipe Line Co.	12	8	Bills & Troth Const.—Extension from Salt Creek, Wyo., to Taylor-Sussex area.
Stanolind Pipe Line Co.	16	6	O. C. Whitaker—Line near Jacksboro, Tex.
Stanolind Pipe Line Co.	75	16	C. S. Foreman—Washington, Kans., and Freeman, Mo., loops, 4-49.
Stanolind Pipe Line Co.	62	12	Sheehan Pipe Line Const. Co.—LaPlata, Mo., and Wood River, Ill., loops, 4-49.
Sunray Oil Corp.	8	6	Pipe Line Service Co.—Tussey Sta. to Velma, Okla.
Texas Empire Pipe Line Co.	183	18	H. C. Price Co., Anderson Bros. Const. Co., Bechtel Corp., Conyes Const Co.—Patoka to Wilmington, Ill.
Texas Empire Pipe Line Co.	47	10	Williams Bros. Corp.—Cushing to West Tulsa, Okla.
The Texas Pipe Line Co.	19	6-8	Latex Const.—Manvel to Chocolate Bayou field, Texas, 1949.
The Texas Pipe Line Co.	46	6-8	Latex Const.—Between Blue Lake Junction & Houston Ship Channel. Take up.
The Texas Pipe Line Co.	55	22	Sheehan Pipe Line Const.—Wood River to Patoka, Ill.
The Texas Pipe Line Co.	35	8	Latex Const.—Chico to Upham, Tex.
The Texas Pipe Line Co.†	173	24	Smith Const.—Wichita Falls, Tex., to Cushing, Okla.
The Texas Pipe Line Co.	15	10-8-6	Associated Pipe Line Contr., Inc.—Wharton County, Texas, Wharton and El Campo, 5-1-49.
Valley Pipe Line Co.	28	10	Pacific Pipe Line & Engrs., Ltd.—Emidio to Elk Hills, Calif., 7-1-49.
Valley Pipe Line Co.	53	10	Pacific Pipe Line & Engrs. Ltd.—Elk Hills to Cottonwood, Calif., 7-1-49.
Valley Pipe Line Co.	72	10	Kettleman Hills to Estero Bay, Calif.

*Ozark Pipe Line System of Shell Pipe Line Corp. and Texas Pipe Line Co. Shell Pipe Line Corp. handled construction. †Basin (Jal-Cushing) 515-mile system of Texas Pipe Line Co., Shell Pipe Line Corp., Empire Pipeline Co., Sinclair Refining Co., Texas Pipe Line Co. handled construction.

TABLE 5—COMPLETED DOMESTIC PRODUCTS PIPE-LINE PROJECTS

Alamo Refining Co.	23	8	Latex Const.—Sweeney to Freeport, Tex.
Buckeye Pipe Line Co.	22	6	H. L. Gentry Const.—Lawrenceville to Robinson, Ill., 8-49.
National Cooperative Ref. Co.	21	6	Gene White—Council Bluff, Iowa, to Irvington, Neb., 7-49.
Plantation Pipe Line Co.	12	8	Latex Const.—Helena, Ark., to Birmingham, Ala., 8-49.
Socony-Vacuum Oil Co., Inc., (Eastern Pipe Line Div.)	22	6	Midwestern Constructors—Malvern-Binghamton to Reading, Pa., 4-49.
Socony-Vacuum Oil Co., Inc.	147	8	Midwestern Constructors—Malvern, Pa., to Binghamton, N. Y., 1-49.

TABLE 6—COMPLETED DOMESTIC NATURAL GAS PIPE-LINE PROJECTS

The California Co.	40	8-6-3	Latex Const.—Near Ruston, La.
Cities Service Gas Co.	26	4-6-12	Knupp Construction Co., Inc.—Hugoton field, Kans., 9-1-49.
Columbia Gas System, Inc.	18	20	Mahoney Contr.—Seneca to Sandusky County, Ohio, 7-8-49.
Columbia Gas System, Inc.	10	12	Britton Contr.—Commonsburg to Bethel Borough, Pa., 9-10-49.
Columbia Gas System, Inc.	24	12	Williams Bros.—Port Jervis to Cochecton, N. Y., 8-25-49.
Dow Chemical Co.	15	4	Latex Const.—Near Bay City, Tex.
Home Gas Co.	20	6-10	Britton Const.—Dundee storage field, New York, 6-1-49.
Hope Natural Gas Co.	13	14	Pipe Line Const. & Drlg. Co.—Hastings, W. Va., 7-1-49.
Kansas-Nebraska Natural Gas Co., Inc.	21	13	Cheek Const.—Scott City, Kans., to South. Looping and replacement, 8-49.
Kansas-Nebraska Natural Gas Co., Inc.	37	13	Rumsey Bros. Pipe Line Const.—Shields to Wakeeney, Kans. Looping, 8-49.
Lone Star Gas Co.	69	20	Eastern Construction Co.—Opelika to Dallas, Tex., 9-1-49.
Lone Star Gas Co.	25	20	Co. crews—Groesbeck to Riesel, Tex., 8-1-49.
Manufacturers Light & Heat Co.	30	6-12	Britton Const.—Majorsville, Pa., area, 6-1-49.
Manufacturers Light & Heat Co.	12	12-16	Britton Const.—Cannonsburg, Pa., area, 6-1-49.
Michigan-Wisconsin Pipe Line Co.	456	24	J. R. Horrigan Const.—Hansford County, Texas, to Maryville, Mo., 1-49.
Minneapolis Gas Light Co.	20	12-16-20	Williams Bros.—Minneapolis.
New York State Natural Gas Corp.	46	16	Williams-Austin Co.—Rasselas, to Genesee, Pa., 6-19-49.
Northern Natural Gas Co.	18	24	Eastern Const.—North of Oakland, Iowa, 9-49.
Northern Natural Gas Co.	21	20	Eastern Const.—North of Palmyra, Neb., 10-49.
Northern Natural Gas Co.	44	5-6-8	Knupp Const.—Gathering lines, Garden City, Kans., 10-49.
Northern Natural Gas Co.	9	24	Eastern Const. Co.—North of Clifton, Kans., 7-49.
Northern Natural Gas Co.	30	24	Eastern Const.—Palmyra to Plattsmouth, Neb., 8-49.
Northern Natural Gas Co.	22	24	G. G. Griffis Const.—North of Ogden, Iowa, 7-49.
Northern Natural Gas Co.	26	24	C. G. Griffis Const.—Albert Lea, to Owatonna, Minn., 8-49.
Northern Natural Gas Co.	11	24	G. G. Griffis Const.—North of Farmington, Minn., 8-49.
Northern Natural Gas Co.	21	24	R. H. Fulton & Co.—West of Garden City, Kans., 10-49.
Northern Natural Gas Co.	46	4-6-8	Knupp Construction Co., Inc.—Hugoton field, Kans., 10-49.
The Ohio Fuel Gas Co.	27	20	Mahoney Contr. Co.—Columbus to Carroll, Ohio, 8-49.
The Ohio Fuel Gas Co.	18	20	Mahoney Contr. Co.—Republic to Fremont, Ohio, 7-49.
Oklahoma Natural Gas Co.	65		Trojan Constr. Co.—Stroud to Moore, Okla. Take up and relay, 8-27-49.
Pacific Lighting Corp.	11	6-8	Pacific Pipeline Const.—Camerillo to Point Mugu, 7-49.
Panhandle Eastern Pipe Line Co.	198	26	R. H. Fulton & Co.-R. B. Potashnick & Co.-Midwestern Constructors—Okla., Kans., Mo., and Ill.
Phillips Petroleum Co.	305	3-24	Vaughn & Taylor Const. Co.—Gathering System, Sherman and Hansford counties, Texas, 9-11-49.

TABLE 6—COMPLETED DOMESTIC NATURAL GAS PIPE-LINE PROJECTS (Continued)

Company—	Miles	Inch	Contractor, location, and completion date
Rocky Mountain Gas Co.	55	8	Dawson & Corbett Pipe Line Welding Co.—Wyoming.
Socony-Vacuum Oil Co., Inc.	22	6	Midwestern Constructors, Inc.—Reading Spur to Reading, Pa., 6-49.
Southern Natural Gas Co.	31	13	Ford, Bacon & Davis Const.—Branch line loop in Ala., 8-49.
Southern Pipe Line Co.	18	6-7-8	Sheppard-Geiger Const.—Edroy to Saxet, Tex.
Stanolind Oil & Gas Co.	63	2-26	Deaton & Sons, Inc.—Gathering system, Fullerton field, Tex., 9-15-49.
Stanolind Oil & Gas Co.	19	4-6	Deaton & Sons, Inc.—Fullerton field to Eunice, N. M., 9-30-49.
Stanolind Oil & Gas Co.	132	4-30	Deaton & Sons, Inc.—Gathering system in Hugoton field, Kansas, 5-1-49.
Stanolind Oil & Gas Co.	130	2-30	Deaton & Sons, Inc.—Gathering system in Levelland field, Texas, 9-1-49.
Stanolind Oil & Gas Co.	23	3-10	Deaton & Sons, Inc.—Gathering system in Fullerton field, Tex. (Water), 6-15-49.
Tennessee Gas Transmission Corp.	50	30	H. C. Price Co.—Greenville to Ruleville, Miss., 9-4-49.
Tennessee Gas Transmission Corp.	62	24-30	H. C. Price Co.—Refugio to Victoria, Tex., 6-28-49.
Tennessee Gas Transmission Corp.	46	24	H. C. Price Co.—Cranell to Victoria, Tex. Looping, 6-4-49.
Tennessee Gas Transmission Corp.	20	30	Morrison Const.—Sabine River to Remlig, Tex. Looping, 6-4-49.
Tennessee Gas Transmission Corp.	57	30	Tennessee Gas Trans.—Ark.-La. State Line to Monroe, La. Looping, 8-4-49.
Tennessee Gas Transmission Corp.	17	30	H. C. Price Co.—Victoria to Inez, Tex. Looping, 6-4-49.
Tennessee Gas Transmission Corp.	53	30	Morrison Const. Co.—Louetta to Trinity River. Looping, 8-4-49.
Tennessee Gas Transmission Corp.	49	30	H. C. Price Co.—Drew to near Miss. River. Looping, 9-4-49.
Texas Eastern Transmission Co.	70	26	Associated Pipe Line Contr.—Somerset to Washington, C. H., Ohio, 8-22-49.
Texas Gas Transmission Corp.	87	26	O. C. Whitaker Co.—Greenville to Lula, Miss., 9-20-49.
Texas Pipe Line Co.	64	12-14-16	H. B. Zachry Co.—San Salvador to Brownsville, Tex., 9-49.
United Gas Pipe Line Co.	90	20	O. C. Whitaker Co.—Baxterville, Miss., to Mobile, Ala., 9-10-49.
United Gas Pipe Line Co.	14	7-8	Brown & Root—West Lake Verret to Oaklawn, La.
United Gas Pipe Line Co.	8	8-10	Wood Eng. & Const.—Panola County, Texas. Connection from Lone Star gasoline plant to United company's Carthage-Longview line.
West Texas Gas Co.	13	6	Brodie Const. Co.—Near Brownfield, Tex., 3-49.
West Texas Gas Co.	13	5	M. L. Moore Const.—Near Olton, Tex., 5-49.
West Texas Gas Co.	11	11	Earl's Welding Shop—Littlefield to Anton, Tex., 10-49.
West Texas Gas Co.	10	6	Earl's Welding Shop—Littlefield to Levelland, Tex., 10-49.

TABLE 7—PRINCIPAL FOREIGN CRUDE-OIL PIPE-LINE PROJECTS

Company—	Miles	Inch	Status	Contractor, location, and completion date
Anglo-Iranian Oil Co., Ltd.	56	20-22	Under way	Agha Jari to Mashur, Iran.
Corporacion de Fomento de Chile	45	8	Under way	Cerro Manantiales (Springhill) to Caleta Clarencia Techint Pipe Line Div., Techint International, S.A. (on Bahia Gente Grande).
Interprovincial Pipe Line Co.	1,150	16-18-20	Planned	Edmonton, Alta., to Superior, Wis., 10-50.
Imperial Oil, Ltd.	85	4-8	Under way	Sparling-Davis Co., Ltd.—Redwater and Deron, Alta., Canada.
Iraq Petroleum Co., Ltd.	556	30-32	Planned	Iraq-Levantine Port.
Iraq Petroleum Co., Ltd.	532	16	Under way	Kirkuk to Tripoli, Lebanon, 1950.
Iraq Petroleum Co., Ltd.	620	16	Under way	Kirkuk to Haifa, Palestine.
Iraq Petroleum Co., Ltd. [Petroleum Dev. (Qatar), Ltd.]	73	13-14	Under way	Dukhan to Umm Said, 1-50.
Iraq Petroleum Co., Ltd.	556	30	Authorized	Kirkuk to Banias, 1952.
Kuwait Oil Co. (Gulf and Anglo-Iranian)	1,100	30	Planned	Kuwait, Arabia, to Levantine Port.
Kuwait Oil Co. (Gulf and Anglo-Iranian)	600	4-30	Under way	Bechtel-Kuwait, Arabia.
Middle East Pipe Line Co.	800	34-36	Planned	Iran-Levantine Port.
Petroleos Mexicanos	145	$12\frac{3}{4}$	Considered	Reynosa to Monterrey, Mexico.
Petroleos Mexicanos	280	$12\frac{3}{4}$	Authorized	Poza Rica to Salamanca, Mexico.
Santos Jundiai Railroad	30	18	Planned	Santos to Sao Paulo, Brazil.
Trans-Arabian Pipe Line Co.	1,067	30-31	Under way	International Bechtel, Inc.-Williams Bros. Corp.-Graver Tank & Mfg. Co.-Chicago Bridge & Iron Co.—Abqaiq, Saudi Arabia, to Sidon, Lebanon.
Yacimientos Petroliferos Fiscales de Argentina	400		Planned	Plaza Huincul to Bahia Blanca, Argentina.

TABLE 8—PRINCIPAL FOREIGN PRODUCTS PIPE-LINE PROJECTS

Petroleos Mexicanos	160	$10\frac{3}{4}$	Authorized	Minatitlan to Salina Cruz, Mexico.
Cia. des Pipe Lines Petroliers Francias	150	10	Planned	Le Havre to Paris, France.
Colombian Government	342		Planned	Puerto Berrio to La Dorada, 92 mi.; La Dorada to Bogota, 110 mi.; La Dorada to Cartago, 140 mi.
Creole Petroleum Corp.	10	8	Authorized	Catia de la Mar to Nueva Caracas, Venezuela.
Ministry of Petroleum of Colombia and Antiogua R.R.	107		Planned	Puerto Berrio to Madellin, Colombia.
Northern Pipe Line, Ltd.	330	10	Planned	Montreal, Que., to Toronto, Ont.
Santos Jundiai Railroad	40	10	Planned	Santos to Sao Paulo to Campinas, Brazil.
Svenska Enterprenad Aktiebolget	220		Planned	Uddevalla to Vasteras, Sweden.
United Kingdom Government	150	6	Completed	Shell Petroleum Co. supervision Mtwara, near Lindi, to Ground Nuts area, Tanganyika, Africa.

TABLE 9—FOREIGN NATURAL-GAS PIPE-LINE PROJECTS

Direccion General del Gas del Estado	500		Planned	Plaza Huincul to Neuquen, Argentina, to the vicinity of General Conesa, Argentina.
Direccion General del Gas del Estado	1,100	10	Under way	Tecnica and government crews—Comodoro Rivadavia-Buenos Aires, Argentina.
Northwest Natural Gas Co.	950	24	Planned	Alberta fields to Vancouver, B. C., Seattle, Wash., and Portland, Ore.
Petroleos Mexicanos	205	16	Considered	Monterrey to Torreon, Mexico.
Petroleos Mexicanos	260	20	Considered	Monterrey-Tampico-Poza Rica area, Mexico.
Petroleos Mexicanos	150	20	Completed	Williams Bros. Co.—Poza Rica to Mexico City.
Petroleos Mexicanos, Mexican Gas Co., and Industrial Gas Co.	600		Planned	Reynosa, Tamaulipas, to Mexico City, D.F., Mexico.
Regie Autonome des Petroles	114	6	Under way	Toulouse-Bordeaux, France.
U.S.S.R. (reported)	360		Under way	Dashiva (in Carpathians) to Kiev, Ukraine.
Westcoast Transmission Co., Ltd.	1,400	30	Planned	North Alberta, Vancouver, B. C., and northern California.
Western Pipe Lines	710	22-24	Planned	Alberta fields, Saskatoon, Alta., to Winnipeg, Man., Canada.

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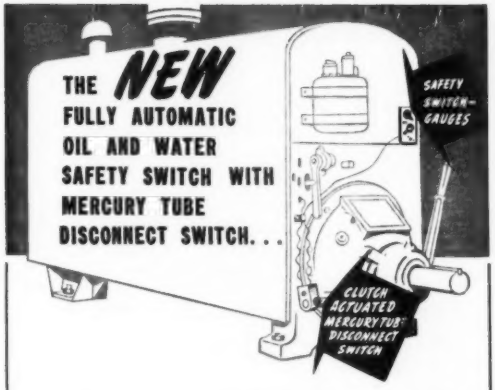
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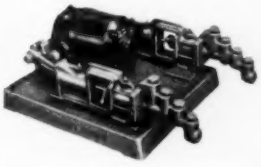

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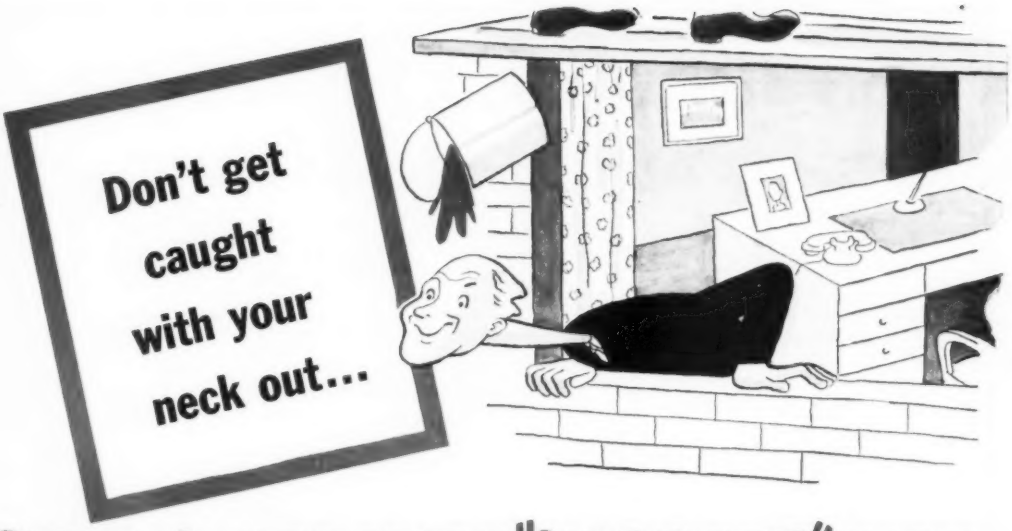

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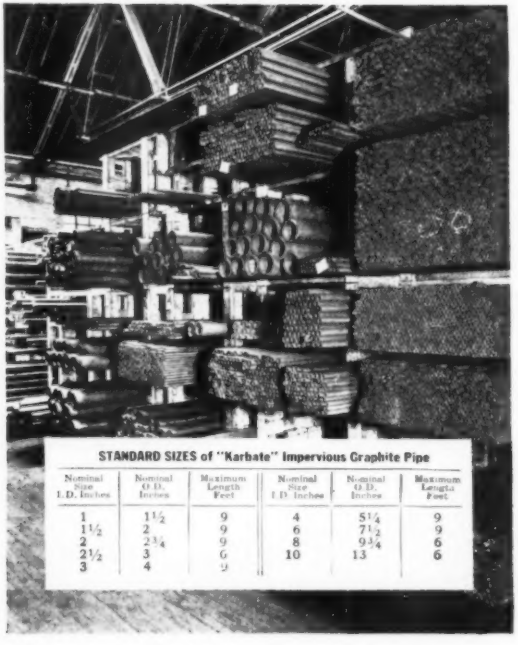

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1	1½	9	4	5¼	9
1½	2	9	6	7½	9
2	2¾	9	8	9¾	6
2½	3	6	10	13	6
3	4	9			

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Cost-imating

A WEEKLY FEATURE OF THE OIL AND GAS JOURNAL

Chemical Equipment—3

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TABLE 1—APPROXIMATE INSTALLED COST (1946) OF WATER-TREATING (DEMINERALIZATION) PLANTS,[1] DOLLARS EACH

Capacity (g.p.m.)	Dollars, 1946
4	1,850
7	3,100
10	4,200
20	7,800
40	15,000
70	25,000
100	35,000
200	65,000

TABLE 2—APPROXIMATE INSTALLED COST (1946) OF CONTINUOUS THICKENERS,[1,2] DOLLARS EACH

Diameter	Single compartment	Two compartment
14	4,550	6,850
20	6,800	10,000
30	9,700	15,500
40	13,000	21,000
50	16,700	27,000
60	20,600	32,500
80	29,600	
100	40,000	

TABLE 3—APPROXIMATE INSTALLED COST (1946) OF FURNACES,[1,3] DOLLARS PER MILLION B.T.U. PER HOUR*

Duty, 10^6 B.t.u. per hour	Tubular furnaces: Steel tubes	Cr steel tubes	Cr Ni steel tubes	Dowtherm units
0.2	3,150			6,100
0.4	4,250			7,900
0.7	5,250			9,800
1.0	6,100			10,900
2.0	8,300			14,200
4.0	12,000			
7.0	16,800			
10.0	21,000	34,000	85,000	
20.0	34,000	57,500	144,000	
40.0	57,500	95,000	233,000	
70.0	86,000	142,000	340,000	

*See also Cost-imating No. 25, April 7, 1949; No. 26, April 14, 1949; No. 27, April 21, 1949; and No. 41, July 28, 1949.

TABLE 4—APPROXIMATE INSTALLED COST (1946) OF GAS HOLDERS[1,3,4] AND GAS* PRODUCERS[1,5]

Gas holders: Capacity (cu. ft.)	Dollars each	Gas producers: Tons gasified per day	Dollars each
1,000	3,500	30	55,000
2,000	5,200	40	63,000
4,000	7,900	50	69,000
7,000	11,000	60	74,500
10,000	13,500	70	79,500
20,000	20,500	80	84,000
40,000	31,500	90	89,000
70,000	44,000	100	93,000
100,000	53,000	110	96,500
200,000	79,000	120	100,000
400,000	119,000	140	107,000
700,000	167,000		
1,000,000	204,000		

*Gas producer costs probably include overhead for engineering and construction.

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2. Tyler, C., "Chemical Engineering Economics," 3rd Ed., McGraw-Hill Book Co., New York, 1948.
3. Happel, Aries & Borns, Equipment Costs and Other Items in Engineering Economics, Chem. Eng., Dec. 1946, p. 97.
4. Williams, R., Chem. Eng., No. 12, 124 (1947).
5. Smoley, Torrey and Kniel, Pet. Refiner, 26, 768 (1947).

No. 51 in a series by W. L. Nelson, professor of petroleum refinery engineering, University of Tulsa

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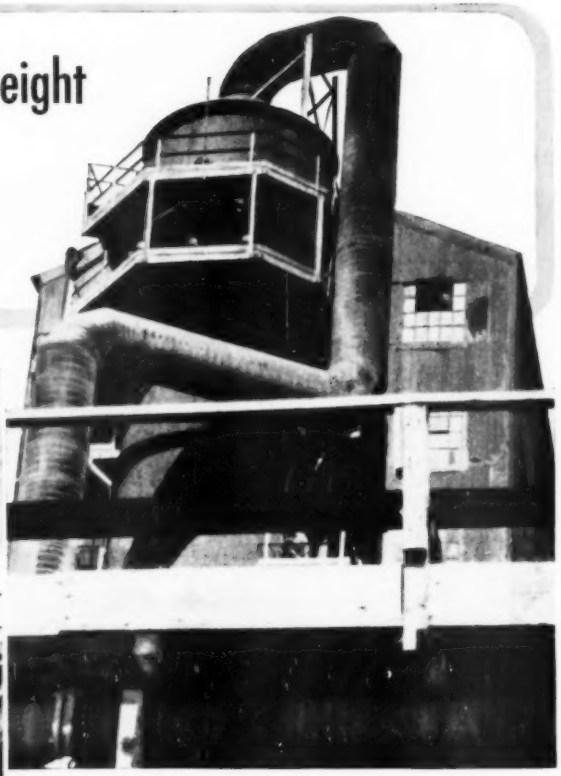
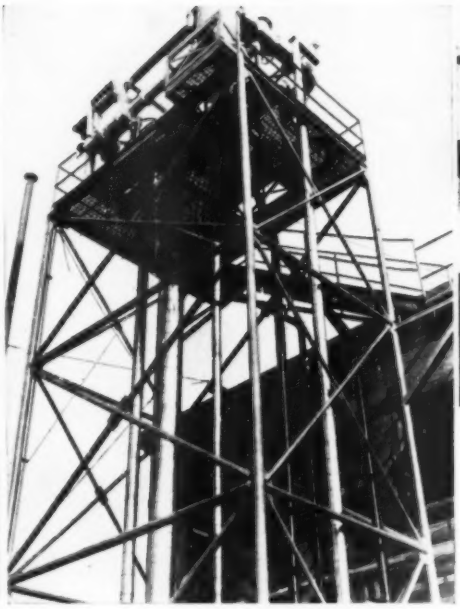


60-inch pipe made of Lukens Stainless-Clad Steel, on a tower at Columbia Chemical Division of Pittsburgh Plate Glass Co., Barberton, Ohio.



10-inch vapor line made of Lukens Stainless-Clad Steel, installed at an oil refinery.

"The piping we formerly used was corrosion-resistant but, by nature, it was *heavy*. Installing it was costly and supporting structures had to be similarly heavy. Now that the cost of clad steel pipe is comparable, we favor it."

Lukens Stainless-Clad Steel was used for the two installations pictured here. With different corrosive conditions, the choice might have been Nickel-Clad, Inconel-Clad or Monel-Clad Steel. Lukens makes them all—uniform claddings of the corrosion-resistant metals, permanently bonded to steel backing plates. Clad Steel pipe is available through various fabricators.

In many cases, processing plants served by such piping can also use Lukens Clad Steels elsewhere to advantage. Equipment is given long life, upkeep is held down and products are safeguarded against contamination. Lukens engineers will help select the claddings you need.

Bulletin 449 tells you more about Lukens Clad Steels. For a copy, write Lukens Steel Company, 455 Lukens Building, Coatesville, Pennsylvania.

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PROGRESS in METALS

by W. L. Nelson
Consulting Engineer

A.S.T.M. Aluminum Condenser Tubes

ALUMINUM condenser and exchanger tubes have been used more and more widely in petroleum services. They have been used in condensing and cooling sweet and sour hydrocarbon gases and liquids, in furfural, and other solvent-extraction lubricating-oil processes, for air and natural-gas compressor intercoolers and aftercoolers, for lubricating-oil and jacket-water coolers on engines, and numerous other services.

The newly adopted tentative A.S.T.M. Standard B234-48T, covering two types of aluminum-alloy drawn tubes, is discussed by Hamilton and Bowman in the July issue of the A.S.T.M. Bulletin, page 44, and much of the following is taken from their paper. Table 1 shows allowable working pressures.

The two alloys are designated M1 and M1 Clad, and they differ principally in that M1 Clad tubes are more resistant to perforation under certain corrosion conditions. For most applications the plain M1 tubes are adequately resistant to corrosion, but when small amounts of the salts of heavy metals such as copper, tin, nickel, or lead are present, the contaminated water may induce severe pitting or perforation of the tubes. Under such conditions, the use of M1 Clad tubes is recommended.

The superior resistance of M1 Clad tubes is the result of an integrally bonded alclad coating on the inside surface of the tube. The coating comprises about 10 per cent of the wall thickness and is of an alloy containing about 1 per cent zinc, which is anodic to the M1 alloy (1.3 per cent manganese, remainder aluminum) in most waters.

The fundamental manner in which an alclad coating protects an aluminum alloy from attack in severely corrosive exposures is so well known that little need be said about it here. The coating alloy, of course, is not completely immune to attack and will, in time, develop pits which penetrate to the bond between the "core" and coating. Electrolytic action then prevents corrosion of the "core" and perforation of the tube, at least until the area of the pit has increased so greatly as to reduce the electrolytic action because of the increased resistance in the electrolyte.

The specification covers tubes in a temper which combines good strength with a generally satisfactory level of workability. With few exceptions, Committee B-7 was informed tubes in this temper can be expanded into tube sheets using the same practices and tools that are used for other materials. If preliminary tests indicate that the workability is inadequate, the tubes can be end annealed and can then be expected to expand as much as 30 per cent using the 60° expansion tool described in A.S.T.M. Specification B 153.

When the operating temperature range is not too great, the aluminum-alloy tubes can be used in conjunction with steel tube sheets without danger of working loose. Corrosion of the ends of the tubes, because of contact with the steel, is generally negligible unless the chloride content of the cooling water exceeds about 50 p.p.m. If brackish or sea water is used, tube sheets of a suitable aluminum alloy should be used. Tube sheets of copper-base alloys must always be avoided.

TABLE 1—ALLOWABLE INTERNAL AND EXTERNAL WORKING PRESSURES FOR M1 AND M1-CLAD TUBES*

Nominal inside diam. (in.)	Nominal wall thickness		For metal temperatures not over (°F.) Allowable internal working pressure, psi.†					Allowable external working pressure, psi.‡				
	In.	Stubs gage	100	200	300	400	500	100	200	300	400	500
3/4	0.049	18	645	590	515	410	290	530	460	360	225	120
	0.065	16	870	800	695	555	390	765	655	515	335	175
7/8	0.049	18	550	505	440	350	245	425	375	295	175	90
	0.065	16	740	680	590	475	335	630	540	425	270	150
	0.083	14	960	885	770	615	430	850	730	575	380	190
1	0.065	16	640	590	515	410	290	525	460	360	220	120
	0.083	14	830	765	665	530	375	725	620	490	315	165
	0.109	12	1,115	1,030	895	715	505	1,000	850	576	435	220
1 1/4	0.065	16	505	465	405	325	230	385	335	265	160	79
	0.083	14	655	605	525	420	295	545	470	370	230	125
	0.109	12	875	805	700	560	395	770	660	520	340	175
	0.120	11	975	895	780	625	440	865	735	580	385	190

*No allowance has been made for any reduced efficiency which may be encountered at joints.

†The allowable internal working pressure, including a factor of safety of 4, is based on the following formula:

$$P = \frac{0.95\,S}{4} \times \frac{D^2 - d^2}{D^2 d^2}$$

where:
S = the minimum tensile strength in psi. D = the nominal outside diameter, in.
d = the nominal inside diameter, in.

The factor 0.95 is used to take care of factors such as the difference between the longitudinal and circumferential tensile strength.

‡The allowable external working pressure, including a factor of safety of 4, is based on the theory developed in "A Study of the Collapsing of Thin-Walled Cylinders," by R. G. Sturm, Bulletin, University of Illinois Engineering Station, Series No. 329.

Low-Temperature Bolting

THE following alloy steel, when in the heat-treated condition, can be used for temperatures down to minus 150° F.

Element	Percentage
Carbon	0.38-0.45
Manganese	0.75-1.00
Phosphorus	0.04
Sulfur	0.04
Silicon	0.20-0.35
Chromium	0.80-1.10
Molybdenum	0.15-0.25

It conforms to A.S.T.M. Specification A320-48T and exhibits a minimum impact strength of 15 ft.-lb., a yield point of 80,000-105,000 psi., and an elongation for a 2-in. gage length of 16-20 per cent. Bethlehem Steel Co. offers such a steel as Bolting Grade L-7.

Forging Terms or Operations

TRIMMING

A semifinishing operation used to cut away excess metal such as the "flash" of drop forgings. The term trimming is usually applied to operations on partly or nearly finished small items whereas the term "hot cutting" is used to trim billets, blanks, coupons, duplicates, etc., preliminary to forming operations. Trimming of the flash is usually the last step in finishing a drop forging.

Sizing presses and power hammers are employed.

DRAWING OUT

The lengthening of stock by impact or pressure. It is used in working down large billets, bar stock, etc. Equipments that may be used for drawing out are: trip hammer, helve hammer, steam hammer, air hammer, forging rolls, or forging press.

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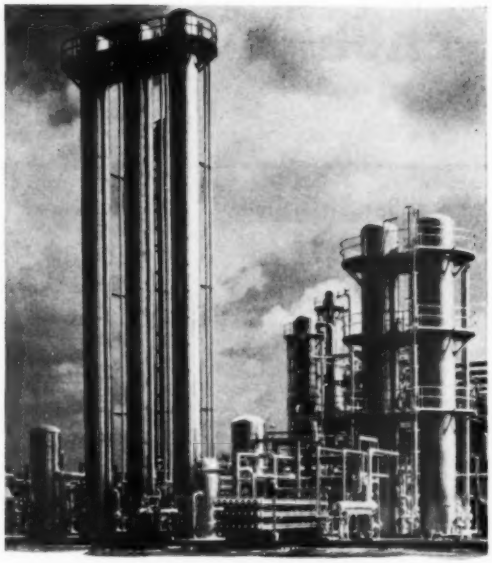

Southwest Gas Producing Co.—Uses

FLORITE

The recently completed gasoline plant of Southwest Gas Producing Company at Dubach, La., gathers wet gas from the surrounding area and employs new highly efficient methods for separating its ethane and propane components. Ninety million cubic feet of natural gas is handled daily, yielding a daily output of 230,000 gallons of liquefied hydrocarbons. The Fish Engineering Corporation of Houston designed and constructed this model plant.

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NATURAL GAS

Texas Eastern Transmission Completes All Work in Ohio

Texas Eastern Transmission Corp. announced today that it has substantially completed all construction work in Ohio necessary to make deliveries this winter under its expansion program designed to raise the capacity of its inch lines ultimately to 740,000,000 cu. ft. a day.

Fifty-five miles of pipe are still to be laid next spring to complete the Ohio construction, the company said, but the 122.5 miles now in the ground, together with additional compressor-station facilities installed, will provide enough capacity to handle all quantities of gas to be received this winter from Texas Gas Transmission Corp.'s new Texas-to-Ohio pipe line new under construction.

The additional gas will be delivered to subsidiaries of Consolidated Natural Gas Corp. and Columbia Gas System and to other utility companies, Texas Eastern stated.

As part of the same construction program, work has been started in Louisiana on one section of 20-in. line that loops the company's Little Big Inch from Station E near Castor, La., northward to a point of connection with the Texas Gas line near Lisbon, La. This supply construction should be completed by the end of the year, the company announced.

Other parts of the program have been scheduled for construction next year, including another section of 20-in. loop in Texas and 100 miles of 16-in. line from the Provident City field in Lavaca County, Texas, to the Baytown, Tex., terminus of the Little Big Inch, Texas Eastern reported.

By the end of the year all construction necessary to make deliveries to Texas Gas at the supply connection at Lisbon, La., will be completed, the company stated.

Court Rules on Mexican Gas-Development Project

A temporary injunction order which would prevent Carr W. Smith, Houston, from carrying out a huge development of natural-gas reserves in Mexico was refused recently by District Judge Phil Woodruff. The judge in effect said the plaintiffs were claiming rights in something which, although it may exist in the future, does not exist.

Three persons had petitioned the court to restrain Smith from continuing the Mexican development, contending that they stand to lose $10,000,000. The court held the plaintiffs have only potential rights in possible profits.

Many Topics to Be Featured At I.N.G.A.A.'s Meeting

Many phases of the natural-gas industry's activities will be covered in papers to be presented at the annual meeting of Independent Natural Gas Association of America, which will be held in Dallas October 31.

The 1-day meeting, to be held in the Baker Hotel, will feature discussions on topics of interest to royalty owners, producers, transporters, and distributors, as well as to members of regulatory agencies and consumers.

Following an address of welcome by Wallace Savage, mayor of Dallas, and the report of I.N.G.A.A. President A. B. Harper, of Fort Smith, Ark., president of the Arkansas-Oklahoma Natural Gas Co., there will be discussions concerning winter-supply problems, with S. B. Irelan of Oklahoma City, president of the Cities Service Gas Co., talking on "Winter Supply Problems of Transporters," and G. A. Staples, Corpus Christi, Tex., Chicago Corp., offering a paper on "Winter Supply Problems of Producers and Gatherers."

After hearing from Rex Baker, Houston, of Humble Oil & Refining Co., on "Legal Problems for the Natural-Gas Industry," the morning session will close with a motion picture showing the activities of the Oklahoma Natural Gas Co.

During the business luncheon, the nominating committee will submit its recommendations for members to serve on the board of directors for the coming year, and the election of board members will follow. Wesley E. Disney, of Tulsa, and Washington, D. C., who is the I.N.G.A.A. counsel, will speak on "A Look Into the Legislative Future."

Opening the afternoon session, Maj. B. A. Hardey, independent operator of Shreveport, will discuss the "Status and Prospects of Natural Gas from Tidelands," and this will be followed by a paper by Dr. Frank H. Dotterweich of the Texas College of Arts & Industries, on "The Competitive Position of Natural Gas Versus Coal, Fuel Oil, Manufactured Gas, and Atomic Energy."

Charles C. Wine of the Arkansas Public Service Commission will talk on "Overlapping Problems of State and Federal Regulation," and then will follow a round-table discussion on "Methods and Laws Relating to Gas Measurements," with the following attorneys participating: Scott Hughes, of Southern Union Gas Co., Dallas; R. R. McCracken, Cities Service Gas Co., Oklahoma City, and Marshall Newcomb of Lone Star Gas Co., Dallas.

After acting on the report of the Resolution Committee, the new board of directors will meet to elect new officers for the coming year.

Willmut Gas Complaint Is Consolidated by FPC

Federal Power Commission has consolidated the proceeding involving Willmut Gas & Oil Co.'s December 1948 complaint against United Gas Pipe Line Co. with the commission's general investigation, instituted in October 1948, of United's rates.

Willmut, which has main offices in Hattiesburg, Miss., alleged in its complaint that the contract rates at which United sells natural gas to Willmut are unjust and unreasonable, and asked FPC to fix just, reasonable, nondiscriminatory, and nonpreferential rates.

The commission is investigating rates, charges, services, or classifications demanded by United in connection with the transportation or sale of natural gas subject to FPC jurisdiction.

United has its principal office in Shreveport, and operates a natural-gas transmission line located in Texas, Mississippi, Louisiana, Alabama, and Florida.

Natural Gasoline

New Method of Quoting Prices Used in Canada

A new method of pricing natural gasoline has been put into effect by Royalite Oil Co., Ltd., at its absorption plant in Turner Valley, Alta.

Starting September 24 Royalite is posting prices f.o.b. plant tankage based on the content of the natural gasoline as shown by analysis determined by Podbielniak fractional distillation apparatus. The prices for the finished product are determined by the percentage of components at the following prices: propane, $0.40 per barrel; butane, $2.26 per barrel; pentanes and heavier, $5.48 per barrel. Prices are in Canadian currency for barrels of 30 Imperial gallons.

So far as can be determined, this is the first time that natural gasoline has ever had a posted price or been priced on analysis of its components. The usual practice in the United States is to base prices on vapor pressure and to sell at prices per gallon as shown by various market-reporting services and trade publications.

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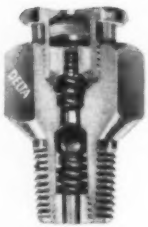

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REFINING

Refinery-Waste Disposal To Feature W.P.R.A. Meet

Two authorities on refinery-waste disposal will be featured as speakers at a regional technical meeting to be sponsored by the Western Petroleum Refiners Association in Chicago on October 21. The meeting, to be held at the Palmer House, has been called to allow member refiners to consider waste-disposal problems in light of new anti-pollution laws which have been adopted in several states.

Leading the discussion will be L. C. Burroughs of Shell Oil Co., New York, and W. B. Hart of Atlantic Refining Co., Philadelphia. Burroughs is currently serving as chairman of the American Petroleum Institute committee on waste disposal. Hart preceded him as chairman of this group. Because of their many years of experience with waste disposal problems, both Burroughs and Hart are recognized as authorities in this field.

At the Chicago meeting, speakers will describe state and federal anti-pollution laws and action. They will further describe the measures recommended by the A.P.I. to assist individual companies solve their waste-disposal problems. They will discuss methods of investigating the extent of stream pollution as a preliminary step to adopting corrective measures. The equipment and procedures for disposing of objectionable wastes will also be considered.

The meeting has prompted considerable interest among member refiners because of the recent tightening up of state and federal conservation laws. Many of the lakes constructed by U. S. agencies for flood-control purposes have been designated as recreation areas, and because certain types of refinery wastes prove harmful to marine life in such lakes, the problem has become even more acute. Both the states and the Government are recognizing the importance of more stringent enforcement measures under anti-pollution laws.

Papers on Lube Additives Feature A.S.T.M. Meeting

SAN FRANCISCO.—A symposium on high-additive-content oils and a special petroleum luncheon are the chief features of interest to oil men on the program of the Pacific area national meeting of the American Society for Testing Materials here October 10-14.

Committee D-2 on petroleum products and lubricants will hold a series of meetings during the convention, and is sponsoring a petroleum luncheon October 12 at which the speaker will be E. A. Evans, president of the Institute of Petroleum (Great Britain), London.

The lubricating symposium will hear papers on "Does Service Performance Justify Higher Quality Lubricating Oils?," by W. B. Bassett, Lubrizol Corp., Cleveland; "High Detergency Motor Oils," by A. B. Boehm, Enjay Co., New York, and C. O. Tongberg, Standard Oil Development Co., New York; and "Progress Report on Ordnance Field Tests of High-Sulfur Fuel in Series 2 Lubricating Oils," by N. L. Klein, Office of the Chief of Ordnance, Department of the Army, Washington.

Also on the A.S.T.M. program are symposiums on bituminous paving mixtures and lubrication of turbines.

Hamman Oil's Refinery at Bay City, Tex., Is Closed

HOUSTON.— The 2,100-bbl. refinery of Hamman Oil & Refining Co. at Bay City in Matagorda County has been closed down, according to an announcement by John Hamman, Jr., president.

"The prices of refined products are not improving fast enough to allow us to continue operations," Hamman said. "We can't continue operating when our refined products are selling at less than the cost of the raw material."

Work Is Resumed at Houston Chemical-Products Plant

HOUSTON.—Work has been resumed at Consolidated Chemical Industries, Inc.'s, plant here, one of three plants shut down in recent weeks by the C.I.O. Oil Workers International Union.

Another of the plants, the refinery of Crown Central Petroleum Corp. at Pasadena, resumed operations last week. No settlement has been reached at Mathieson Chemical Corp.'s sulfuric-acid plant.

Taxes From Oil Continue Above Those of Last Year

WASHINGTON. — Treasury collections from the three oil taxes were $10,300,000 greater than last year for the month of August, but for the first 8 months of the calendar year receipts were only $10,750,000 ahead of

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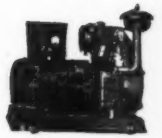

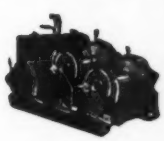

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last year, it was disclosed last week by the Internal Revenue Bureau.

The bureau's report showed that August collections included $10,268,-254 from lubricating oils, against $6,-401,968 for the same month last year; $49,116,140 from gasoline, against $42,-972,350; and $1,811,875 from pipe-line transportation, while for the 8-month period lubricating oil returned $56,-719,781 against $53,913,674, gasoline $318,709,050 against $310,366,114, and pipe line transportation $12,352,791 against $12,848,501.

The bureau reported that collections from all taxes were greater in August than in the same month last year but the increase was not sufficient to offset a sharp decline in July, and receipts for the first 2 months of the fiscal year were some $72,500,000 under those a year ago. Of 79 categories of taxes, 49 showed decreases for the 2-month period.

Hovey Cites Chief Problem Of Refining Industry

HOUSTON.—Chief problem of the refining industry is the narrow margin between the price of crude and the wholesale prices of refinery products, D. W. Hovey, president of the Gulf Coast Refiners Association, asserted here last week.

Hovey made this statement in connection with an announcement that his association was changing its qualifications for membership to include refiners all over the country.

"These wholesale prices must be adjusted," he said, "or many independent refiners will be forced out of business. That would remove an important competitive element in the oil industry."

Regulation Order Opens Synthetic-Rubber Markets

WASHINGTON.—Losing no time in making effective the agreements reached during the recent talks between the financial leaders of the United States, Britain, and Canada, the administration has relaxed the requirements for use of synthetic rubber by American tire manufacturers, opening a market for an additional 50,000 long tons of natural rubber.

New regulations have been issued by the Department of Commerce reducing the amounts of synthetic which must be used in tires and lifting entirely the requirement for the use of butyl in inner tubes. However, it is provided that should the total annual consumption of butyl be indicated as less than 15,000 tons, its use may again be made mandatory.

Under the new regulations, it is figured that the estimated consumption of 925,000 long tons of new rubber next year will consist of 642,000 tons of natural and 283,000 tons of synthetic.

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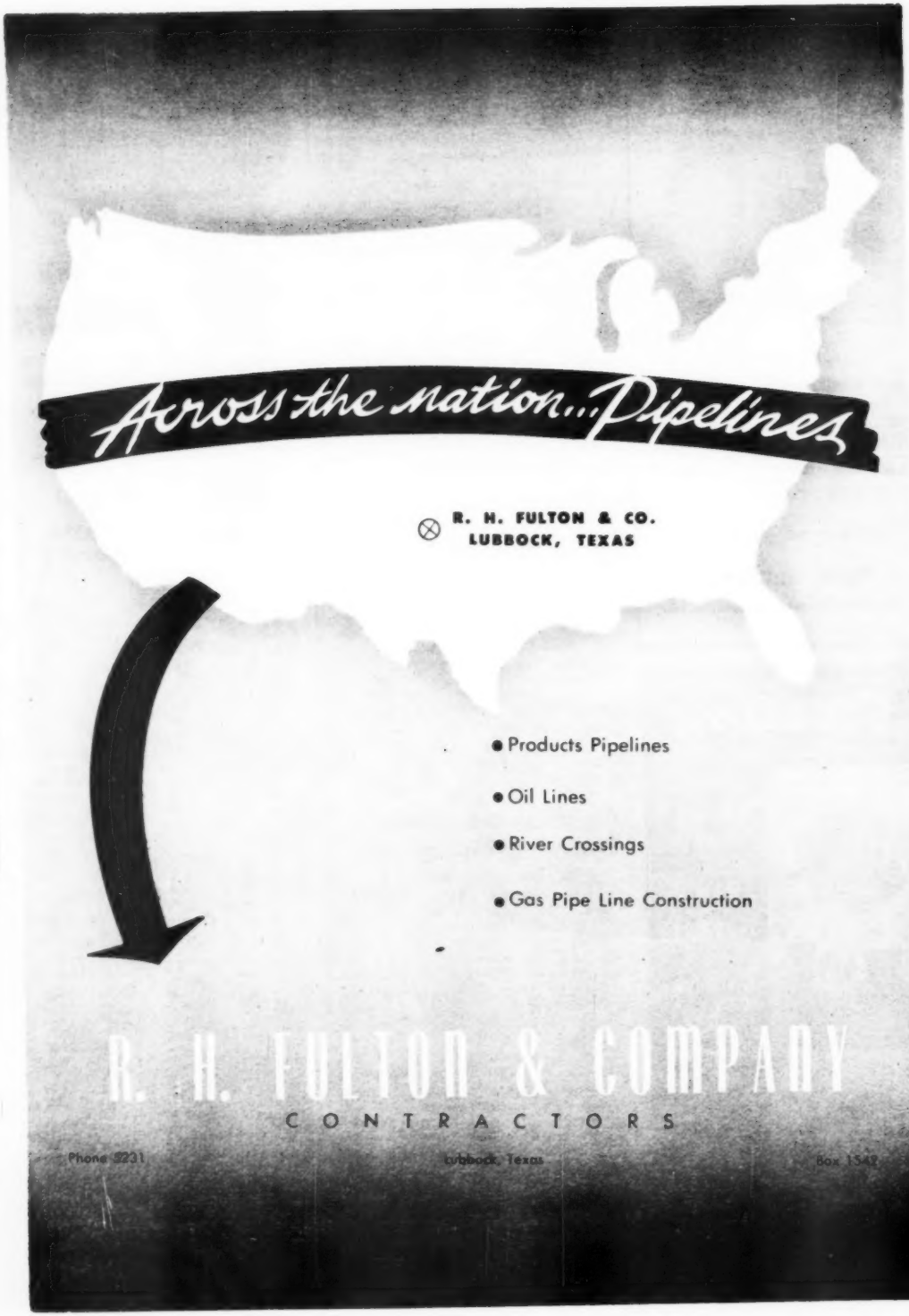
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PIPE LINES

El Paso Natural Engaged In 1,168-Mile Program

Projects completed in 1949 and under construction by El Paso Natural Gas Co. total 1,168 miles. These include 224 miles of projects completed in 1949 and 944 miles of projects under way for which 166 miles have already been laid.

The largest current undertaking of the company is the construction of 629 miles of 30-in. looping which parallels the 741-mile, 26-in. line laid in 1947 from Jal, N. M., to Blythe, Calif. For this 30-in. looping project, construction crews have laid 116 miles; the project will be completed about April 1950.

From the Benedum field, Texas, to the company's Keystone main-line plant near Kermit, Tex., company crews have laid 50 miles for a 95-mile, 20 and 24-in. project, which is scheduled for completion this month.

Other projects under construction by El Paso Natural are the following: 106-mile, 30-in., Salome, Ariz.,-Needles, Calif., line (to connect with the 26 and 30-in., Texas-California trunk line) scheduled for completion about April 1950; 76-mile, 2-3-4-6-in., to White Sand Proving Ground, N. M., Holloman U. S. Air Base, and Alamogordo, N. M.; 11-mile, 10-in., loop to Phoenix, Ariz., scheduled for early completion; 27-mile, 16-in. loop of El Paso Natural's 14-in. from the company's Fullerton plant to the 30-in. transfer line (to be completed in November).

The principal projects completed this year include: 130 miles, 6-8-10-in. from 26-in. trunk line to Globe-Miami, Ariz.; 27-mile, 8-in., Santa Rosa field-Sealy-Smith plant, Monahans, Tex.; and 26-mile, 16-in., connecting the Goldsmith and Keystone field plants, Texas.

Baxterville-Mobile Line Completed by United Gas

United Gas Pipe Line Co. has completed the 90-mile, 20-in. line from the Baxterville, Miss., field to the Mobile, Ala.,-Pensacola, Fla., area. This project was contracted by O. C. Whitaker Co.

The new line is reported to have capacity of 100,000,000 cu. ft. daily. Prior to the building of this line gas was furnished to the Mobile-Pensacola area by a system transmitting from the Louisiana fields having a capacity of 60,000,000 cu. ft.

60-Mile Line to Be Built By Ohio Fuel in Project

Federal Power Commission has authorized Ohio Fuel Gas Co., Columbus, to construct and operate facilities for expansion of the company's

Cleaning and priming operations on 22-in. pipe laid for Michigan-Wisconsin Pipe Line Co.'s trunk line being completed this year for transmitting natural gas from the Texas Panhandle to Wisconsin and Michigan. Work shown in the photograph is at the 198-mile section contracted as a joint venture by Oklahoma Contracting Co. and J. R. Horrigan Construction Co. between Big Rapids, Mich., and a point near the Illinois-Indiana border. Construction of this section is to be completed within a few days

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underground natural-gas storage capacity by approximately 16,600,000,000 cu. ft., which will bring the total ultimate capacity to about 59,300,000,000 cu. ft.

Under the authorization, Ohio Fuel will convert six natural-gas producing pools in Medina, Lorain, Richland, and Hocking counties, Ohio, to underground-storage service. The company also will construct about 59.8 miles of pipe line to be used in connection with the storage operations and retire approximately 53.1 miles of existing well and field lines.

Total estimated cost of the proposed construction is $1,090,975, for which Ohio Fuel plans to arrange a loan from its parent corporation, Columbia Gas System, Inc., subject to SEC approval.

Ohio Fuel said that because of declining production in local fields, it is necessary for the company to receive increased deliveries from out-of-state sources. In order to accept this gas in quantities necessary to meet winter demands, it is necessary to place large volumes in underground storage in summer for withdrawal in winter, the company added. Ohio Fuel said it has not plans for serving any new markets through the storage program.

Inventors of War Pipe Line to Be Awarded

Four British inventors who enabled 1,000,000 gal. of gasoline daily to be delivered from Britain to Europe during the war are to receive £15,000 ($42,000) tax free, in recognition of their services, it was learned recently. The award was recommended by the British Royal Commission on Awards to Inventors.

Experts had considered a pipe line under the English Channel to be an impossible project, but Messrs. Hartley, chief engineer of Anglo-Iranian Oil Co., Ltd., designed a hollow cable that could be laid by ship from a revolving drum; Ellis, of the Burma Oil Co., Ltd., conceived the idea of winding a pipe on a welded drum; Purvis, ship overseer for Cammell Laird, was concerned with the design and development of the drum; and Price, of Iraq Petroleum Co., Ltd., contributed a wedge-gripping device for fixing the pipe line into position.

Hearings on Worland Gas Line to Be Resumed by FPC

In response to a flood of inquiries concerning the construction of the proposed natural-gas pipe line from Worland gas field in Wyoming to Baker, Mont., by Montana-Dakota Utilities Co. and Montana-Wyoming Gas Pipe Line Co., Federal Power Commission has announced that hearings will be resumed in the certificate proceedings on October 17, 1949.

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Parkhill is now stringing 480 miles of 22" pipe for Shell Oil Company's Cushing, Okla. to Wood River, Ill. pipe line. Parkhill has the facilities to string any size pipe over any type terrain. Let Parkhill expedite the construction of your next line and add you to their long list of satisfied customers.

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Allied Constructed pipeline pumping stations, (above) at Kilgore and (right) at Cheney, Kans.

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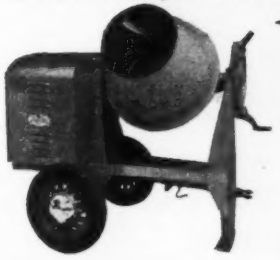

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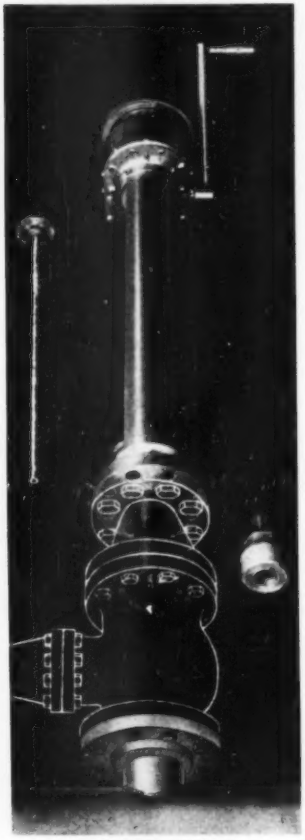

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Nominal cutter sizes 1½" to 4". Ball and roller bearings in all main journals.

MODEL 600 for TAPS UP TO 12"

*Patent No. 2,097,398
Other Patents Pending.

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CLEANS PIPE LINES
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provided that the companies are able to proceed. The commission also announced that it is and has been ready to go ahead on any other date prior thereto.

The hearings commenced August 22 in Washington, D. C., and continued until September 1, when counsel for the two companies requested a recess until the middle of October "to afford an opportunity to attempt to negotiate a more favorable contract with the Pure Oil Co., which would assure some commitment on the part of the Pure Oil Co. . . ."

In ruling on the motion, the FPC presiding examiner granted to the two companies a recess until October 17 to give them an opportunity to obtain necessary information and "if possible a firm commitment in reference to the supply of gas . . ."

If Montana-Wyoming and Montana Dakota can obtain a firm supply of natural gas, the proposed project, if authorized by the commission, would make available an additional 35,000,000 cu. ft. of natural gas per day to customers of Montana - Dakota in Montana and North and South Dakota. Estimated cost of the construction is $8,419,880.

The companies' proposal includes plans for a 340-mile 12¾-in. pipe line extending from the Worland field in Washakie County, Wyoming, to Montana Dakota's Cabin Creek compressor station in Fallon County, Montana; a combination gas - compressor, dehydration, and sulfur-removal plant near the Wyoming origin of the line; and two branch lines, one connecting with the present gas-distribution system at Miles City, Mont., and other connecting with a distribution system to be built by Montana Dakota in Forsyth, Mont.

The 340-mile main pipe line and combination plant would be constructed and owned by Montana-Wyoming and operated under lease by Montana Dakota. The branch lines would be constructed, owned, and operated by Montana Dakota.

Both Montana - Wyoming, a new corporation, and Montana Dakota have main offices in Minneapolis.

FPC Consolidates Texas Eastern Transmission's Case

Federal Power Commission has consolidated an application filed by Texas Eastern Transmission Corp. with proceedings, previously consolidated and set for hearing, involving five applications relating to the construction of pipe-line facilities which would be used for the transportation and sale of natural gas by Manufacturers Light & Heat Co. to the distribution companies serving the Harrisburg, Allentown, Bethlehem, Reading, and Lancaster, Pa., areas. The commission at the same time postponed hearing on the consolidated proceedings from September 28 to October 17 in Washington, D. C.

Two joints of 30" pipe welded together to form a length 62' long, shown in the final Bending Stage in the "Cinch" Bender. Note how the pipe was bent continuously through the Welded Joint. This demonstration established firmly, quality on an Economical Basis.

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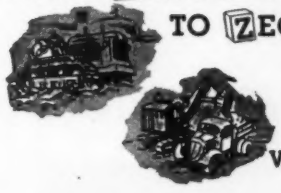

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Calibration	custom calibrated in accordance with SMT-51.
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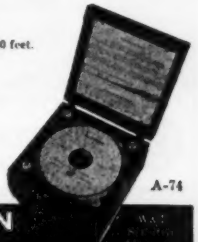
Case	Hardwood or metal with shock-proofing for mechanism.



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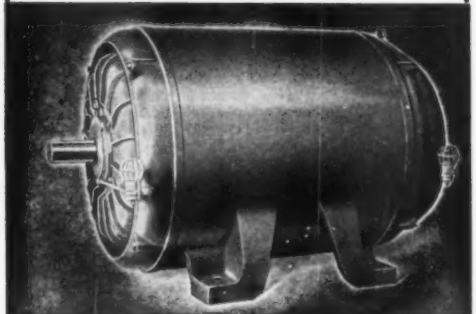

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Among the

Drilling Contractors

New Contracting Company Operates in Illinois Area

Freeman Lomelino, independent operator in the Illinois basin region, has announced the organization of B. L. S. Drilling Co. to engage in contracting with main offices at Olney, Ill. Lomelino is president; Allen Bickel, vice president; and Hubert A. Schien, secretary.

R. C. Patton, Wichita, is starting a wildcat test for Eddie Fisher in northwestern Harper County, Kansas. The location, 1 Biberstein, in 14-32-9, is 2 miles northwest of Attica. Nearest production is in the Whelan pool, 17 miles northwest in Barber County.

Johnson and Flesher Drilling Co., Oklahoma City, is contractor for Ray P. Diehl at the latter's 1 Hall, 10-16n-3e, northwest of Tryon, Lincoln County, Oklahoma, a prospective new pool opener. The well found favorable oil and gas showings in a drillstem test of Red Fork sand at 4,141-53 ft., but currently is being deepened for a look at the Bartlesville sand.

Masters Drilling Co. has taken the contract for drilling Independent Exploration Co. 1 Irvine, a wildcat in 23-6s-10w, Fairview area, Orange County, California.

James Smith, Wichita Falls, Tex., is moving in rig to a rank wildcat location in 34-9n-25w, 2 miles west of Erick, Beckham County, Oklahoma, for a projected 5,000-ft. test to be drilled for V. J. Devine.

ROTARY RIGS IN OPERATION*
(United States and Western Canada)

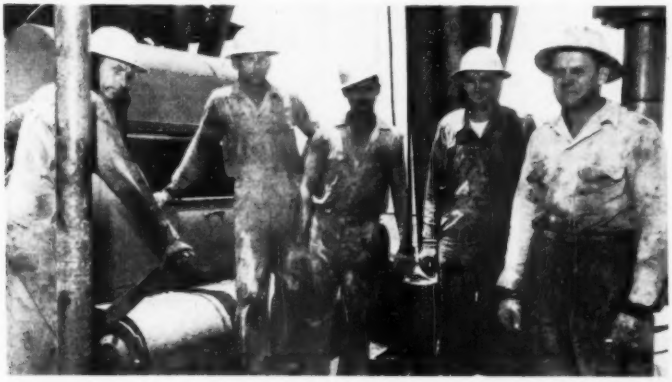
Area	Week ended 9-26-49	Change week ended 9-19-49	Change week ended 9-27-48
Gulf Coast	510	—35	— 66
W. Tex.-N. M.	561	+29	— 38
Ark.-N. La.-E. Tex.	151	0	— 29
Oklahoma	222	+18	— 68
Kansas	122	+ 8	— 19
Illinois-Eastern	100	—10	— 53
Rocky Mountains	105	0	— 63
Pacific Coast	154	—14	— 10
Total United States	1,925	— 4	—346
Western Canada	65	— 2	+ 10
Total	1,990	— 6	—336

*Courtesy Hughes Tool Co.

G. P. Shoultz, Francisco, Ind., is starting a new operation for R. D. Brown, Inc., at 4 Tolbert, 29-1n-9w, in the Union-Bowman pool, Pike County, Indiana.

Rex & Morris Drilling Co., Eldorado, Kans., is the contractor for Eldorado Refining Co. on a wildcat test being drilled 1½ miles east of Keighley, in 25-27-7e, Butler County, Kansas. The test, 1 Butts, is 2 miles east of production in the Keighley pool.

Bodard Drilling Co. has operations under way at Gulf Coast Western Oil Co. 1 Sions, 21-12n-9e, northwest of the East Castle pool, Okfuskee



Mangum Drilling Co., Houston, working for Claud B. Hamill in the Buck Snag field, Colorado County, Texas Gulf Coast, has as its day-tour crew on its No. 3 rig the following, left to right: J. E. Craig, driller; Louis Ressman, derrickman; R. J. Koeniq, motorman; L. H. Esch and Louis Popp, floormen

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For oil field, locomotive type and marine boilers. Water shows black — steam shows white; the water level is unmistakable. U-Bolt construction is strongest and simplest to service. Glass replaced by simply removing nuts on face of gage . . . unnecessary to work between gage and boiler. Conforms with A.S.M.E., Federal and State requirements when used for pressures specified by their respective codes.

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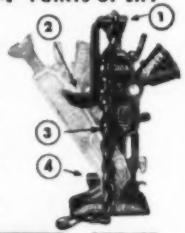

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Simplex LEVER . SCREW . HYDRAULIC Jacks

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County, Oklahoma. The test will be carried through the Wilcox, expected around 4,200 ft.

Crescent Drilling Co., Inc., Monroe, La., is the contractor for Woodley Petroleum Co. at 1 Knox, 20-23n-8w, a Smackover B zone well being started in the Haynesville field, Claiborne Parish, Louisiana.

W. C. Patton, Stillwater, Okla., who recently completed a well (1 Leach) for Blackwell Oil & Gas Co. in 22-19n-5e, Payne County, Oklahoma, has moved the rig to the new pool opened by Thomas N. Berry in 10-18n-4e, about 9 miles southwest, same county, where he is starting an east offset to the discovery well for the latter operator.

M. J. Delany Co., Dallas, is the contractor on a semi-wildcat test, 1 Witt, being started for C. Andrade III, in the L. Rufty Survey, south of the Lasseter field, Marion County, Texas.

Harry L. Morgan, Shreveport, has contracted with Morgan & Norton, Inc., to drill a 9,000-ft. test in 35-3n-6w, 3 miles north of Leaksville, Greene County, Mississippi. Location is on the Byrd farm.

Creighton Drilling Co., Tulsa, is drilling a projected 5,300-ft. wildcat test for C. P. Quinlan at 1 Collier, 33-19n-1w, Payne County, Oklahoma.

Shaw Petroleum Drillers, Ltd., has been awarded contract for drilling Spike-Redwater 1, a 2-mile step-out test from the Blackfoot producing sector of the Lloydminster "black" oil district on the Alberta-Saskatchewan Province line, western Canada. Location is in LSD 10, 28-49-2w4th.

Warren and Bradshaw Drilling Co., Tulsa, is starting a Wilcox sand wildcat test for Stanolind Oil & Gas Co. at 1 Woods, 18-15n-7e, north of the Southwest Milfay gas pool, Creek County, Oklahoma. Wilcox is expected around 4,500 ft.

E. M. Shields, Sr., Butler, Pa., contractor on 2 of the 3 wells which have been drilled for Gaspe Oil Ventures, Ltd., and associates of Montreal on Gaspe peninsula, Quebec Province, Canada, has been given the contract for acidizing and completing all the wells, and personally is supervising the operations.

Keyes, Marken & Grannel, now drilling a deep test for Pioneer Oil Co. in the south part of the Kevin-Sunburst field, Toole County, Montana, will move the rig, when this hole is completed, to a location 6 miles north in the northwestern part of the field, where they have the contract for another deep test to be drilled for Lee Edwards. This is the first rotary rig ever operated in this field.

White-Webb Drilling Co., Dallas, has contracted with W. A. Moncrief to drill 1 W. C. McCoy, a wildcat test in the R. G. Cartwright Survey, 2 miles south of Elmo, Kaufman County, Texas. Hole will be carried to the Paluxy sand.

Dave Morgan Drilling Co., Blackwell, Okla., is drilling a well for **Olson Drilling Co.,** Tulsa, at the latter's 1 Bennett, 2-27n-3w, in the Webb pool, Grant County, Oklahoma.

McAlester Fuel Co., Magnolia, Ark., is the contractor for R. W. Burnett on a wildcat test being drilled in 35-12s-31w, a mile south of Arden, Little River County, Arkansas. The well, 1-C Sively, is projected to 3,500 ft.

Acuff & Allison have the contract for a Devonian-Cambrian test to be drilled for The Texas Co. on the latter's Kiemele lease in 26-31n-13e, west of Laredo in Southern Hill County, Montana. The test, the first on this block, is projected to 6,000 ft. Rig is being moved in from a well recently completed for Northern Ordnance Co. on the Bowes structure in Blaine County.

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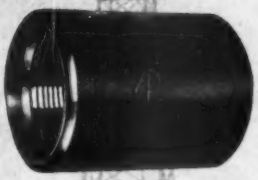

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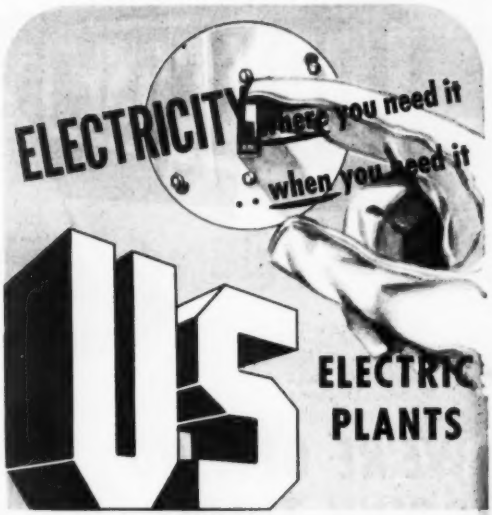

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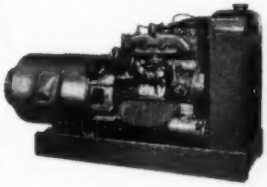

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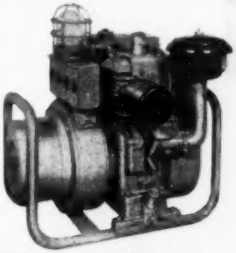

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Exploration and Drilling

West Texas Pegasus Field Looks Big

WHEN Republic Natural Gas Co. 1 Powell, 2 miles southeast of the discovery well of Pegasus field, found some oil in the Ellenburger, to many geologists it was merely what they expected. Ever since Magnolia Petroleum Co. opened this field with a strike near the Upton-Midland county line last spring, geologists familiar with the area have had it pegged as a major discovery.

Everybody agreed that both seismic and subsurface interpretation indicated a big structure. The discovery well, and those offsets that are deep enough, as well as Republic's step-out, have had drill-stem tests that indicated medium to large production in several pays en route to the Ellenburger. Apparently it is going to produce from one or perhaps more Permian pays, as well as from two to four pre-Permian pays. Or, more conservatively, it looks like there are four to six pays that will produce at some place on the structure.

For the moment it is not certain how good the Republic extension well is going to be in the Ellenburger. It is of course quite a bit low compared to the discovery, but not too low. It may turn out to be an edge well in that pay. Or it may turn out that present difficulties are mechanical and that as soon as the pay is cleaned up, big production will be obtained from the Ellenburger. In that case someone will have to drill an Ellenburger test still farther down structure to find the edge. Drilling 13,000-ft. Ellenburger tests will be a time-consuming proposition, so it will be quite a while before the full story is proved.

One of the first results of the Pegasus discovery was to intensify interest in the gap between Benedum field and Pegasus. There are several ways of figuring the geological trend, and naturally there have been differences of opinion. But with the opening of Pegasus, coming after the Benedum discovery, there could be little argument that there was a trend running from Big Lake through Benedum and up to Pegasus. South and southeast or east from Big Lake, there was and still is room for argument, but not to the northwest.

So far no one has filled in the gap with a discovery. Checking a trend on a small-scale map and locating an oil field at 12,000-14,000 ft. deep in the wide open spaces of West Texas are two entirely different geological and geophysical tricks. But with enough operators backing enough different geological interpretations of local areas and drilling deep wildcats along the trend, most geologists would give odds that another field will be found, perhaps more than one.

Then there is another problem that gets new impetus from the Pegasus strikes, plus the excitement about Pennsylvania limestone reef discoveries in Scurry, Mitchell, Howard, and Borden counties. There are more than a few geologists doing some basic thinking about the whys and wherefores of oil accumulation. Why should so much oil accumulate in such a small area, or in exactly the same spot in rocks that are hundreds of millions of years apart in age? Why should the Big Lake-Benedum-Pegasus trend head on a course that if continued will intersect the Central Platform fields? Does the apparent trend from Howard-Glasscock field through Iatan, Westbrook, Sharon Ridge, and into the new Scurry County production mean anything? Sure, some of it is Permian and some pre-Permian. But look at the Central Platform, where the same thing is true.

Some of them even speculate that some day the whole Midland Black Shale basin from Crockett County north will be filled in with oil fields, and that these will connect up with the Eastern Shelf area. Some go even farther and say that this in turn will connect up with Bend Arch area of North and West Central Texas. They will tell you to look at a pool outline map of southeastern Kansas and northeastern Oklahoma if you doubt their ideas.

At least they all agree there is a lot of oil to be found in West Texas.

Charles J. Deegan.

HIGHLIGHTS OF WEEK'S DEVELOPMENTS

WEST TEXAS.—Between North Snyder and Kelly Canyon fields, Scurry County, Standard-Fryer Drilling Co. 1 E. S. Wilkirson confirmed production linking the two areas. The well was understood to be making more than 30 bbl. of oil an hour, through ½-in. choke, on preliminary tests, and with top of the reef logged at 6,601 ft., had 301 ft. of pay section. Long-range importance of Pegasus field, Upton and Midland counties, pre-Permian multiple pay area, has been noted by observers as stepouts in several directions have indicated commercial production from the Devonian to the Ordovician. Drilling, however, is slow and expensive.

ROCKY MOUNTAIN AREA.—Northern Ordnance, Inc., swabbed 323 bbl. of oil in 21½ hours from its new pay discovery at Bowes, Montana. Ohio Oil Co. has two new failures in the first Dakota in the new Gurley area, Nebraska. In Colorado, Pure Oil Co. is drilling below 4,270 ft. at its Horsefly wildcat.

LOUISIANA GULF COAST.—Superior Oil Co. has completed the A-1 State Lease 1164 as a gas discovery approximately 24 miles off the Cameron Parish coast. The well flowed 5,335,000 cu. ft. of gas per day with a spray of 43.5 -gravity condensate through a 20 64-in. choke from perforations at 5,798-5,834 ft. Magnolia Petroleum Co. A-2 State Lease, Block 72, approximately 11 miles off Terrebonne Parish, had a flow of pipe line oil on drill-stem test. If the test is completed as an oil well, it will be the company's first in the Gulf of Mexico.

CANADA.—Imperial Oil Ltd., tested good oil showings at its Simmons 1, 3½ miles southeast of Redwater field in LSD 1, 25-56-21w4, Alberta Province. The well either may open a new pool, or prove an extension to the field.

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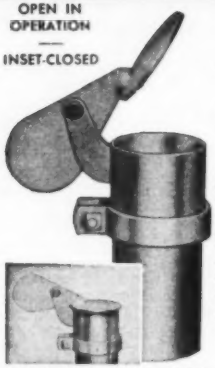

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CALIFORNIA

Two Fields Get Good Extensions

LOS ANGELES.—Both Guijarral Hills and South Cuyama fields came in for extensions this week. Robert S. Lytle completed his 45-34F in Section 34-20s-16e, for initial production estimated at 1,250 bbl. per day, 38° gravity. This well carries proven area to the west, but tests the Allison sand only. Total deoth is 8,169 ft. with the Allison topped at 8,074 ft. with base at 8,164 ft. The other known productive sand in this area, the Leda, lies below the Allison.

Another Lytle well completed in the 35 block of 20s-16e topped the Allison sand at 8,293 ft. and the Leda at 8,762 ft. This well is 46-35F. It came in flowing 1,296 bbl. per day from the Leda sand.

Two Richfield Oil Corp. wells extended the South Cuyama field south and northwest. Hibberd 34-6 at 6-9n-26w reached Gray sand at 4,329 ft. and was plugged back to get production from the oil sand topped at 3,980 ft. This well offsets the Bell Corp. well which first carried production in this direction.

To the south 18-36 Hibberd after initial flow has been placed on the pump. This well extended production a half mile but its failure to flow may mean it is an edge well. However, 250 ft. of oil sand were found in this well.

Humble will make another try in Cuyama Valley on the property of the Santa Margarita Land & Cattle Co. This will make the fourth try here for Humble, three previous tests having failed to find production. The test is 1 Santa Margarita Land & Cattle Co. and is in Section 36-32s-19e.

A new fault block discovery has been made by the Carneros Oil Co. in the Cymric area of Kern County. The find constitutes an addition to the Salt Creek field. Depth indicates it is a block of the Carneros pool. The well is 4 Anderson Comm., 19-29s-21e. It came in flowing 125 bbl. per day, 23.9° gravity. Total depth 2,420 ft. with top of the Phacoides sand at 2,368 ft.

After a series of production tests the Rose L. Bright well, 1 Bright, on the Tejon Ranch, Kern County, flowed 300 bbl. per day of 26 -gravity oil. Production is from the lower 40 ft. of what is reported as better than 800 ft. of oil sand. The sand now producing is apparently below the Reserve sand, and proves up a new zone as well as an extension to the Reserve area of the Tejon Ranch.

The deep test of Shell Oil Co. at East Inglewood, Los Angeles County, is not looking very hopeful on tests. So far only a trace of oil has been recovered by swabbing the interval 11,724-13,507 ft. Activity is now suspended with total depth at 13,509 ft.

Some interest is being shown in the areas beyond the east edge of the Cuyama Valley. Recent property acquisitions in the Topa-Topa and Pine Mountain areas have led to reports of planned drilling at these points.

CALIFORNIA SUCCESSFUL WILDCAT

Kern County, Cymric area: Carneros Oil Co., 4 Anderson Comm., 19-29s-21e, flowing 125 bbl. daily, 23.9° gr., 9 per cent cut, top Phacoides oil sand 2,368 ft., TD 2,420 ft. This well opens a new fault block in the Salt Creek field.

CALIFORNIA WILDCAT FAILURES

Kern County, East Union Avenue area: General Petroleum Corp. 56X4 Bankam, 4-30s-28e, dry, TD 4,927 ft.

Edison area: Universal Consolidated Oil Co., 1 Newbery-Gibson, 27-30s-29e, dry, TD 4,444 ft.

Kern Bluff area: National Steel & Shipbuilding Corp., 1 National-State, 30-29s-29e, dry, TD 2,050 ft. Formerly 1 Blodgett of National Iron Wks.

Kings County, Middle Dome South area: Standard Oil Co., 68-4Z SF & FL, 4-24s-19e, dry, top Miocene 7,060 ft., 1st Temblor 8,665 ft., Felix Silt 10,075 ft., Whepley Shale 10,350 ft., Belridge 64 sand 10,477 ft., TD 11,925 ft., elev. 434 ft.

Los Angeles County, Belridge area: Boyle Royalties, 104-1 Boyle Comm., 31-1s-12w, dry, TD 4,500 ft.

Monterey County, Peachtree Bow area: The Texas Co., 1 Reynolds, 6-21s-12e, dry, TD 2,457 ft.

Orange County, Talbert area: Jergins Oil Co., 1 Ellis, 32-5s-10w, dry, TD 7,586 ft.

San Bernardino County, Chino Hills area: Tide Water Assoc. Oil Co., 1 Abacherli, 12-3s-8w, dry, TD 4,977 ft.

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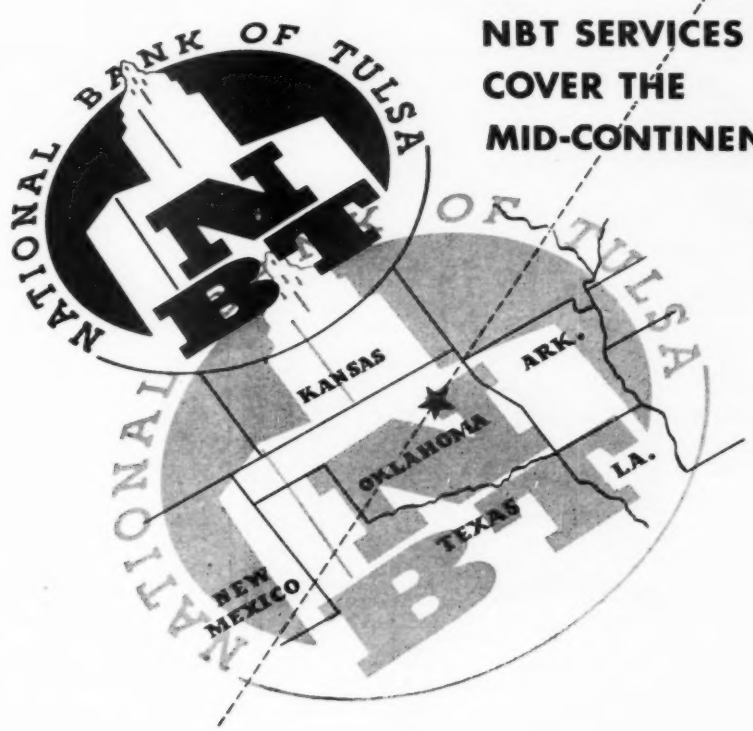

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HOUSTON, TEXAS

San Luis Obispo County, Elkhorn Valley area: M. R. Yant, 1 Yant, 28-32s-22e, dry, bottomed in Pliocene, TD 1,852 ft.

La Panza area: Yellowstone Oil Co. 1 Lewis, 24-29s-16e, dry, top Painted Rocks 1,308 ft., TD 1,314 ft., elev. 1,950 ft.

Santa Barbara County, Cuyama Valley area: Richfield Oil Corp., B-1 Wegis-Reyes, 17-9n-25w, dry, TD 7,500 ft.

Purissima Hills area: Seaboard Oil Co., 4 G. Buell, 24-7n-32w, dry, top Chert 2,300 ft., base 2,640 ft., top Knoxville 2,715 ft., TD 2,975 ft. in Knoxville.

KANSAS

Russell County Wildcat Shows for New Discovery

DISCOVERY of a new pool 3 miles east of the Fairport pool in northwestern Russell County is indicated by results of a drill-stem test in Anschultz Drilling Co. 1 Eulert, NW NW SE 35-11-15. In Arbuckle lime, topped at 3,314 ft. (—1,453 ft.) and drilled to 3,319 ft., the test, with tool open 20 minutes, gave a recovery of 625 ft. of clean oil. Casing has been run to the top of the pay and standard tools are being moved in to drill plug and complete.

In the meantime, A. H. Adair 1 Froelick, SW SE SE 27-12-16, 2 miles west of the Fairport pool and about 2½ miles south of the small Blue Hill pool, in Ellis County, is opening another new producing area for that part of the state. After drilling plug in the Arbuckle, topped at 3,541 ft. (—1,471 ft.), and in which rotary hole had been drilled to 3,543 ft., the well had a 2,000-ft. oil fillup. Formation will be acidized before testing is started.

Anschultz Drilling Co. 1 Smith, NW NW SW 24-22-14, which opens another new producing area in Stafford County to be known as the Oscar pool, has been given a completion potential rating of 250 bbl. per day on the pump following tests in which it swabbed up to 15 bbl. an hour. Production is from Arbuckle lime, topped at 3,797 ft. (—1,870 ft.) with bottom of the hole at 3,805 ft. The discovery is 3 miles southwest of the Curtis pool and 2 miles northwest the Hart pool, recently opened by the same company.

L. P. Stableford and B and B Drilling Co. have confirmed the discovery of the recently opened Huffstutter pool in Phillips County by the completion of their 1 Frank Huffstetter, NE SE NE 6-2-18, which pumped 60 bbl. per day on potential test from Kansas City-Lansing lime with casing perforated at 3,470-87 ft. The section in this well, a 10-acre south offset to the discovery well, drilled by the same operators, was topped at 3,365 ft. (—1,136 ft.), 3 ft. higher than in the first well. A third well, a diagonal southeast offset to the discovery well and northeast of the second, is now drilling.

KANSAS SUCCESSFUL WILDCATS

Barton County: Ben F. Brack 1 Koch, NW NW NW 19-17s-14w, IP 36 bbl., Arbuckle, 3,400-11 ft., TD 3,411 ft.

Pawnee County: Jayhawk Drilling Co. et al 1 Lirks, NE NE SW 23-20s-16w, IP 250 bbl., Arbuckle, 3,760-75 ft., TD 3,775 ft.

KANSAS WILDCAT FAILURES

Butler County: Penguin Drilling Co. et al 1 Anderson, NW NW SW 28-26s-3e, dry, TD 2,860 ft.

R. J. Wixson 1 Hopkins, SE SW NE 17-26s-4e, dry, TD 2,719 ft.

Graham County: M. B. Armer et al 1 Baldwin, SE SE SE 28-9s-21w, dry, TD 4,002 ft.

Stafford County: M. B. Armer 1 Tretbar, NW NW NE 1-23s-11w, dry, TD 3,745 ft.

Sumner County: Sullivan et al 1 Railing, SW SW SW 32-30s-1w, dry, 4,067 ft.

Wabaunsee County: Alfred Landon et al 1 Waugh, SW SW NW 11-13s-12e, dry, TD 3,142 ft.

B & R Drilling Co. et al 1 Schultz, SE SE NW 22-14s-10e, dry, TD 3,614 ft.

Woodson County: W. A. Haney et al 1 Lewis, NW NW NE 2-25s-14e, dry, TD 1,630 ft.

NEBRASKA WILDCAT FAILURES

Cheyenne County: Roberts Brothers 1 Elsasser, C NE NW 25-14n-50w, dry, TD 4,729 ft.

Sidney area, Cheyenne County: Roberts Brothers 1 Elaasser, C NE NW 25-14n-50w, 4,729 TD, plugged and abandoned, perf. 4,679-4,709, muddy water with show of oil.

Ogallala, Keith County: Kimball Development et al 1 State, C SW SW 16-14n-37w, 3,030 TD, plugged and abandoned.

N. CENTRAL TEXAS

Parker County Test Completed

WICHITA FALLS.—Completion tests were made this week at Buzz Morgan and others' 1 Darrell O'Neal, W. Waugh Survey, Ellenburger discovery in northern Parker County, 2 miles northwest of Springtown.

The well gaged 32.6 bbl. of 45.5°-gravity oil a day through 20/64-in. choke, with a high gas-oil ratio. Production was through perforations from 6,662-85 ft., after treatment with 5,000 gal. of acid. Cities Service Oil Co. has made connections to the well. Location of the well is about 5 miles south and slightly east of the Daly, oil and distillate field of Wise County.

Jack County.—Glasscock & Pontiac Oil & Refining Co. 2 Morris & Kempner, Fields Survey, completed for 226 bbl. of oil a day through ¾-in. choke, from pay at 5,504-22 ft. Gas-oil ratio was 525 cu. ft. It is a north extension well in the Glasscock conglomerate area of northeast Jack and northwest Wise counties.

Three miles north of Perrin, J. J. Lynn 1 L. A. Cranford, A. Ferguson Survey, was drilling at 4,050 ft. in shale and sand.

Location for a 5,200-ft. wildcat in northeastern Jack County was made by Wrightsman Oil Co., Fort Worth, as the 1 W. J. Dees, George Taylor Survey, A-843. It is 1½ miles southwest of Vineyard, 4 miles north of the Joplin field and 5 miles northeast of the Steed-Worsham field.

On the southeast edge of the Steed-Worsham Bend conglomerate field, Paul P. Steed 1 J. M. Dickenson, B. Straughn Survey, indicated commercial production when it recovered 3,400 ft. of oil on a 30-minute drill-stem test from 4,599-4,614 ft. Gas showed at the surface in 2 minutes. Operators set casing at 4,601 ft. to complete.

Throckmorton County.—Fred M. Manning, Inc., 3, Unit K, R. A. Brown, Block 244, BBB&C Survey, east outpost to the Manning-Herrington Strawn sand field, 5 miles northwest of Throckmorton, topped the pay sand at 3,879 ft., and drilled to 3,883 ft. Operators were coring ahead from that point. Structure was said to be level with the nearest producers.

Humble Oil & Refining Co. 4 Kirk Ledbetter, Block 2, W. S. Riddle Survey, south offset to the Ranger lime discovery in south-central Throckmorton, recovered 30 ft. of oil and gas-cut mud, with 120 ft. of gas, on a 1-hour drill-stem test from 4,793-4,811 ft. Operators set casing at 4,723 ft. for completion tests.

Taylor County.—An east extension to the Lawn Gardner sand field was in the process of completion, while two other tests were in or near the pay sand.

J. P. Production Co. 2 N. V. Atwood, James C. Thompson Survey 433, located 1,169 ft. east of the discovery, gaged 339 bbl. of 41°-gravity oil in 24 hours, flowing from open hole between 4,092-4,120 ft. It was gaged through ½-in. choke, with gas-oil ratio of 429 cu. ft. Casing was set at 4,085 ft.

The same operators were drilling below 3,000 ft. in the 1 M. G. Reed, J. C. Thompson Survey, which is an east offset to the 2 Atwood.

North of the discovery, Humble 1 J. M. Wagstaff, Block 432, A. Winters Survey, was having caving trouble in the Gardner sand, and was cleaning out after shooting. Details were not disclosed, but it was said to have made a good show of oil on a drill-stem test of the sand.

NORTH CENTRAL TEXAS (DISTRICTS 9 AND 7-B) SUCCESSFUL WILDCATS

Coleman County: Dunham Young and Shield 1 Calvin Campbell Mary Ann Fisk Sur. 630, 3½ mi. E Santa Anna, flowed 419 bbl. 29.8°-gravity oil a day, 10/64-in. choke, Marble Falls 2,311-55 ft., TD, GOR 210 cu. ft., TP 300 psi., CP 600 psi., used 5,000 gal. acid.

Stephens County: The Texas Co. 1 O. T. Tomlin, Sec. 87, BAL Sur., 8 mi. SW Breckenridge, flowed 4,100,000 cu. ft. of gas a day, open flow, CP 624 psi., TP 428 psi., shut-in 1,478 psi., Lake sand pay perforated 3,610-22 ft., TD 3,950 ft., PB 3,676 ft., elevation 1,220 ft.

Young County: Walter Grammar 1 Mrs. Addie Carter, Sec. 1594, TE&L Sur., 8 mi. W Olney, pumped 7 bbl. 38°-gravity oil a day, top pay 1,186 ft., TD 1,187 ft.

NORTH CENTRAL TEXAS (DISTRICTS 9 AND 7-B) WILDCAT FAILURES

Brown County: J. E. Connally 2 O. L. Kellar, Robert Mitchell Sur. 151, 6 mi. SE Cross Cut, dry, TD 1,960 ft., Caddo 1,931 ft. yielded 6 ft. of oil-cut mud on DST.

Callahan County: Rambo & Stephens 1 Homer Pope, Sec. 76, BBB&C Sur., 1 mi. SE Clyde, dry, TD 1,895 ft.

L. M. White 1 J. C. Freeman, Blk. 60, Comal CSL, 5 mi. SW Cross Plains, dry, TD 484 ft.

Coleman County: Tom F. Grisham 1 R. L. Bates, H. Warfield Sur. 22, 4¼ mi. W Novice, dry, TD 4,206 ft., Gardner 3,810 ft., Caddo 4,103 ft., swabbed some oil from Caddo after acid treatment.

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Cooke County: Broadway Drilling Co. 1 Ada Williams, J. M. Burton Sur., A-189, 7 mi. NE St. Jo, dry, TD 2,890 ft.

Eastland County: Price Crawley 1 L. A. Thompson, Blk. 49, Lge. 3 & 4, McLennon CSL, 8 mi. SW Ranger, dry, TD 1,701 ft.

Fisher County: Progress Petroleum Co. 1 J. H. Logan, Sec. 3, Blk. 22, T&P, 1¼ mi. E Gannon, dry, TD 6,310 ft., anhydrite 2,790 ft., Flippen 4,120 ft., no reef logged, elevation 2,251 ft.

Haskell County: A. A. Cameron and Randolph Scott 1 W. B. Griffith, L. Dyches Sur. 46, A-118, 9 mi. SE Haskell, dry, TD 3,626 ft., Marble Falls 2,925 ft., Palo Pinto 3,470 ft.

Montague County: G. E. Kadane & Sons 1 J. G. Spencer "A," S. J. Doake Sur., A-211, 4 mi. NE St. Jo, dry, TD 3,290 ft., sand with water 2,419 ft.

Shackelford County: Dick Schwab 4-A Chloe A. Nail, Sec. 123, ETRR Sur., 15 mi. N Albany, dry, TD 1,620 ft.

L. A. Warren 1 J. B. Mathews, Sec. 20, BAL Sur., 4 mi. SE Albany, dry, TD 962 ft.

Taylor County: Ungren & Frazier 1 L. N. Brown, Jose Gabo Sur. 126, 2½ mi. NW Tye, dry, TD 2,805 ft.

PERMIAN BASIN

Two Scurry County Fields May Connect

MIDLAND.—Standard-Fryer Drilling Co. 1 Edwin S. Wilkirson, Section 17, Block 1, J. P. Smith Survey, considered a link test between the Kelly and North Snyder fields of Scurry County, was waiting on cement after setting casing at 6,614 ft. The well flowed an estimated 50 bbl. of oil an hour on a 75-minute drill-stem test from 6,619-50 ft. Gas came to the surface in 14 minutes, mud in 44 and oil at the end of 53 minutes. The well was allowed to flow into pits for 22 minutes, but was not gaged.

Open flowing bottom-hole pressure was 1,250 psi. Top on the Canyon reef was 6,601 ft., on an elevation of 2,375 ft. It logged 323 ft. of lime section above the water level.

Full details had not been reported at Stanolind Oil & Gas Co. 1-A J. G. Whatley, north outpost to the North Snyder field in 548-97-H&TC. At last report it was drilling ahead below 7,025 ft. in sand and shale, and was to drill ahead to the Ellenburger. According to observers, it was still above the reef and above the water level of the producing area.

Sunray Oil Corp. 1 Sentell, Tract 2, Section 26, Block 1, J. P. Smith Survey, east outpost to North Snyder, had total depth at 7,026 ft. and prepared to drill ahead. A 50-minute drill-stem test at 7,018-26 ft., in the reef, recovered 6 ft. of drilling mud with no shows. It topped the reef at 7,015 ft., minus 4,528 ft., which had no shows.

Eleven miles east of Snyder, C. L. Norsworthy, Jr., 1 D. D. Feldman, 53-3-H&TC, was drilling below 6,160 ft. in lime and shale, with good fluorescence reported at 6,002 ft. and 6,101-09 ft. According to operators, the well had not yet entered the reef lime.

Borden County.—Two miles northwest of its 1 Williams, Ellenburger discovery, Sinclair Oil & Gas Co. 1 Reynolds, SE SW 33-32-T6N-EL&RR, recovered 540 ft. of water blanket, and 20 ft. of 29.9°-gravity oil on a 1-hour and 50-minute drill-stem test of the Mississippian from 9,785-9,839 ft. Flowing pressure was 240 psi., and shut-in pressure was 540 psi. The discovery well had some shows in the Mississippi lime, and was completed in the Ellenburger at 9,915-45 ft. The 1 Reynolds was drilling ahead below 9,854 ft.

Sinclair 1 Bryan, north of the discovery in SE SE Section 40, was drilling below 9,791 ft. in lime and chert.

Sinclair 1 Turner, one location east offset, was drilling past 9,791 ft. One mile west of the discovery, Sinclair 1 Mrs. Rosa Pratt, SE NE Section 44, was drilling at 9,564 ft. All wells were scheduled to the Ellenburger, or around 10,000 ft.

In southeastern Borden County, Amerada Petroleum Corp. planned to drill its 1 N. C. Von Roeder in SE SW 103-25-H&TC, to 7,000 ft. to test the Canyon lime. Location is about 2 miles southeast of the same company's 1 J. R. Canning, 117-25-H&TC, which was drilling below 7,956 ft. in lime and shale. The 1 Canning reported water in the Canyon lime.

Pecos County.—Prospects of production from two new pay zones, the San Andres lime and the Waddell sand, were reported at Richardson & Bass 1 Texas Cotton Industries, 1,980 ft. from northwest lines of 13-3-H&TC, 1½ miles west of the Abell Ellenburger field.

On an elevation of 2,404 ft., the well topped the San Andres at 2,200 ft. Full details were not available, but a 12-hour drill-stem test of that section flowed 60 to 65 bbl. of oil. Final 24-hour test was said to be 126 bbl. of 33°-gravity oil, plus 39 per cent water, flowing through ½-in. choke.

Top of the Waddell sand was 6,130 ft. A 2-hour drill-stem test from 6,115-40 ft. had gas in 3 minutes and recovered 210 ft. of mud-cut oil, 904 ft. of clean oil and 1,786 ft. of drilling fluid testing 17 per cent salt water. A second 2-hour test from 6,143-63 ft. had gas in 5 minutes, mud in 87 and oil in 90 minutes. After cleaning into pits the well flowed at the rate of 288 bbl. of oil a day, over the last 30 minutes.

A test of the Ellenburger from 6,571-6,603 ft. had only salty, sulfur water. Five-inch casing was set at 6,321 ft. for production tests.

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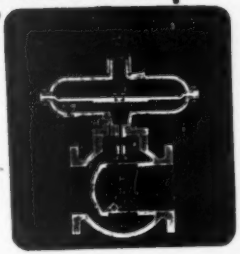

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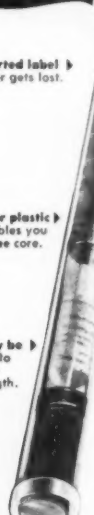

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1 V. J. Powell, 44-40-T4S-T&P, southeast extension to the Pegasus field, continued testing, and was to be completed dually from the Ellenburger and Silurian.

Initial treatment of 2,000 gal. of acid was followed by a 10,000-gal. injection, and the well was swabbed for 2 hours before it kicked off, flowing acid water and some oil into pits for 3 hours. When turned into tanks, it made 98 bbl. of oil and acid water in 12 hours, flowing through $^{3}/_{4}$-in. choke. During the last 4 hours of the test, it averaged around 5 bbl. of oil per hour.

Magnolia Petroleum Co. 2-30 Roy Glass, northeast offset (Midland County), was coming out of the hole with testing tool after an unsatisfactory drill-stem test from 12,827-872 ft. Gas showed at the surface in 5 minutes, but the packer had failed in 20 minutes.

Magnolia 1-36 Glass, southwest offset, was drilling below 12,485 ft. in sandy lime and shale, identified as Simpson.

Four miles northwest of the Benedum field, Humble Oil & Refining Co. 1 Z. Oswalt, 12-B-CCSD&RGNG, recovered 300 ft. of mud on a 70-minute test from 10,335-383 ft., and was drilling ahead.

WEST TEXAS (DISTRICTS 8 AND 7-C) SUCCESSFUL WILDCATS

Pecos County: C. S. Chancellor and Slick Oil Co. 1 Thorton Davis, NW SE 105-8-H&GN, 2 mi. W Pecos Valley, flowed 6,400,000 cu. ft. gas a day, plus 185 bbl. of 62°-gravity distillate a day, perforated Ellenburger 9,125-9,485 ft., potential rated on 12-hr. test through $^{3}/_{8}$-in. chokes, flowing bottom-hole pressure 4,443 psi., top Ellenburger 7,680 ft., TD 9,795 ft., PB 9,560 ft., carried on field reports as completed shut-in gas well.

Schleicher County: Ohio Oil Co. 1 A. L. Baugh, SE SE 18-M-GH&SA, $5^{1}/_{2}$ mi. N and slightly W Page Strawn field, pumped 50 bbl. 39.8°-gravity oil and 250 bbl. salt water a day, top Strawn pay 5,790 ft., TD 6,775 ft., PB 5,812 ft., elevation 2,410 ft.

Scurry County: Stanolind Oil & Gas Co. (formerly Superior and Intex) 1 R. H. Jordan, 680 ft. from E, 2,652 ft. from N lines, 579-97-H&TC, NW corner of county, pumped 47.3 bbl. 39.8°-gravity oil a day, plus 30 bbl. salt water, Mississippian perforations 8,220-60 ft., TD 8,922 ft., PB 8,350 ft., top Mississippian 8,190 ft., Ellenburger 8,412 ft., pre-Cambrian 8,905 ft., elevation 2,779 ft.

WEST TEXAS (DISTRICTS 8 AND 7-C) WILDCAT FAILURES

Crockett County: Lotfland Bros. 1 L. B. Cox, 25-2-I&GN, 25 mi. SW Ozona, dry, TD 1,078 ft.

Pecos County: Union Oil Co. 1-C J. R. Bennett, Sec. 592, GC&SF Sur., A-5262, dry, TD 1,309 ft., Yates 940 ft., elevation 2,549 ft.

Sutton County: Transwestern Royalty Co. and Alaska Steamship Co. 1 John I. King, approximately NE NE 24-K-GH&SA, 20 mi. NE Sonora, $1^{1}/_{2}$ mi. E of gas production, dry, TD 5,250 ft., Palo Pinto 3,696 ft., Strawn 4,650 ft., Ellenburger 5,142 ft., elevation 2,369 ft.

SOUTHEASTERN NEW MEXICO

HOBBS.—Buffalo Oil Co. 3 Comanche Unit, SW NW 26-11s-26e, Chaves County wildcat, ran $5^{1}/_{2}$-in. casing to 6,007 ft. with 100 sacks, drilled out to 5,974 ft., and ran electrical survey. Twelve jet shots from 5,954-57 ft. resulted in swabbing an estimated 10 to 15 gal. of salt water per hour, with a trace of gas. Acidizing was attempted and the formation took 30 gal. It was then plugged back to 5,951 ft. and jet perforated with 24 shots at 5,938-41 ft. Two-inch tubing was run to 5,938 ft., with packer at 5,920 ft., for further testing.

Humble Oil & Refining Co. 1 Wiggs, SW NE 31-24s-27e, Eddy County wildcat, was drilling beelow 11,785 ft., following a drill-stem test from 11,600-61 ft. The tool was open 1 hour, had gas in 15 minutes, and recovered 1,440 ft. of slightly gas-cut mud.

In Bagley field, Mid-Continent Petroleum Corp. 1-65 State, SW NW 1-12s-33e, $^{1}/_{2}$-mile northeast offset to the discovery, swabbed 25 bbl. of oil and 35 bbl. of water in 12 hours from perforations at 8,930-80 ft. Total depth was 9,352 ft., plugged back to 9,075 ft.

Amerada Petroleum Corp. 1-B-TC, north of the Bagley discovery, was drilling below 10,216 ft. Amerada 1-BTD, SE SW 2-12s-33e, southwest extension try, was drilling in lime at 8,451 ft.

McAlester Fuel Oil Co. 1 J. M. Denton, SW SE 11-15s-37e, perforated with 540 jet shots from 11,375-11,464 ft., after setting $5^{1}/_{2}$-in. casing to 11,465 ft. A drill-stem test from 11,346-11,464 ft., open 12 hours and 40 minutes, had gas in 20 minutes, oil in 2 hours and 15 minutes, and flowed 9 bbl. of oil an hour through $^{1}/_{2}$-in. choke. With $^{3}/_{4}$-in. choke, the flow was about 11 bbl. of oil an hour. When the tool was closed it unloaded some 7,000 ft. of oil.

An additional 200 jet shots were placed from 11,325-375 ft. With packer on tubing at 11,300 ft., the well flowed 30 bbl. of oil an hour for 8 hours through $^{1}/_{2}$-in. choke, under tubing pressure of 350 psi. Following that it flowed 21 bbl. of oil an hour for 7 hours, with the same choke, and tubing pressure of 400 psi.

Amerada 1 Rose Eaves, SE SW 35-16s-38e, south offset to the Knowles Devonian discovery, was drilling in lime at 11,373 ft.

Amerada 1 Stella Bennett Rose, 35-16s-38e, north offset to the discovery, swabbed 121 bbl. of 47°-gravity oil in 24 hours, then treated with 500 gal. from 12,596-12,607 ft., and flowed 148 bbl. of oil in 18 hours, cut 5 per cent with acid water. Total depth was 12,607 ft. Five-inch casing was set at 12,596 ft. with 600 sacks.

C. L. Norsworthy, Jr., 1 Shell-Waldrop, NW SW 6-20s-39e, 1 mile east of production in House field, was shut down for orders at 8,000 ft., after a 1-hour drill-stem test from 7,985-8,000 ft. recovered sulfur-water-cut mud, plus 4,140 ft. of sulfur water. Tentative top on the Devonian was 7,988 ft. Elevation was 3,586 ft.

SOUTHEAST NEW MEXICO WILDCAT FAILURES

Eddy County: Blackwell Oil & Gas Co. 1 Barnett, 25-26s-38e, $4^{1}/_{2}$ mi. S Red Bluff, dry, TD 2,867 ft., Delaware lime 2,665

(Continued on page 393)

SOUTH LOUISIANA

Gas and Condensate Tested Near Holly Beach Field

NEW ORLEANS.—Magnolia Petroleum Co. is testing gas and condensate in 1 Henry Heirs, west offset to 1 Abel West Heirs "Holly Beach" discovery well, Cameron Parish. On initial test the well gaged 36 bbl. of condensate and 2,500,000 cu. ft. of gas per day through a 10/64-in. choke. The test is bottomed at 11,484 ft. and is plugged back to 10,814 ft. Production is through perforations at 10,655-60 ft. with bottom-hole flowing pressure at 3,970 psi.

Drill-stem test will be run on Union Producing Co. and M. H. "Pat" Marr 1 Hudson, wildcat 1 mile north of production in Big Island field, 11-4n-3e, Rapides Parish. Recovery from the latest core from 9,976-97 ft. was 14 ft. of fractured lime (Fredericksburg) showing oil and 7 ft. of shale. Ultimate goal is the Paluxy sand which is anticipated around 10,500 ft.

Approximately 24 miles off the Cameron Parish coast, Superior Oil Co. has completed A-1 State Lease 1164 as a gas discovery. The well flowed 5,335,000 cu. ft. of gas per day with a spray of 43.5°-gravity condensate through a 20/64-in. choke from perforations at 5,798-5,834 ft. with 2,300 psi pressure on the tubing. The test was drilled to a total depth of 9,380 ft. and an earlier drill-stem test at 7,150-60 ft. showed a considerable amount of gas, but the operators decided to complete in shallower sands. This completion brings to three the number of shut-in gas discoveries for Superior.

Meanwhile, further to the east and south of Caillou Bay, Magnolia Petroleum Co. had a flow of pipe-line oil on drill-stem test at A-2 State Lease, Block 72, approximately 11 miles off Terrebonne Parish.

The test was made through perforations at 6,990-96 ft., but was not considered satisfactory due to a sudden flow of salt water. If the test is completed as an oiler, it will be Magnolia's first in the Gulf of Mexico.

Another possible discovery is Union Oil Co. of California 1 State Lease 1,700, approximately 700 ft. south of the Vermilion Bay shore line in the Tigre Lagoon area, Iberia Parish. Drill-stem test at 10,856-59 ft. recovered an unestimated amount of gas with a small amount of distillate. Perforations were squeezed and the operators moved down to 11,400-15 ft. where they are preparing to complete the well.

The 25 new locations in South Louisiana include 4 wildcat starts, 1 each in Avoyelles and Cameron parishes and 2 in Acadia Parish. There was one successful exploratory test completed in Acadia Parish, while one was dry in Cameron Parish.

SOUTH LOUISIANA SUCCESSFUL WILDCAT

Acadia Parish: New pay, at So. Bayou Mallet—Union Sulphur Co. 1-A Richard Unit, 25-7s-1e, top sand 9,177 ft., TD 9,651 ft., perf. 9,177-82 ft., IP: 62 bbl. oil per day, 9/64-in. choke, GOR 500, TP 1,320 psi., 30° gravity.

SOUTH LOUISIANA WILDCAT FAILURE

Cameron Parish: H. L. Hunt 1 State Lease 1689, Mallard Bay, 15-13s-3w, dry, TD 9,882 ft.

MICHIGAN

New Field Reported in Michigan "Thumb" Area

MOUNT PLEASANT.—Showing 900 ft. of free oil, natural, from the Dundee in 3 hours, O. H. O'Neal 1 Winchester, SE NE NE 21-14n-10w, Elmwood Township wildcat, Tuscola County, showed for almost certain commercial completion and a new field discovery in the thumb area of the Michigan mitten.

Dundee lime in the new Tuscola strike was logged at 2,557 ft. and hole was bottomed out at 2,740 ft. for test. Pay, it was believed, started to show at about 2,735 ft. A strong gas head was showing and operator believed that hole would continue to fill to flow point, but well was shut in awaiting tubing and tank storage before being tested further.

The 1 Winchester is located just 660 ft. south of a test drilled by Shell Oil Co. in 1945 which was rated a near-commercial well in the Dundee after test had been bottomed out in the Sylvania dry, plugged back to the Dundee objective where 5-in. casing was perforated with 80 shots. The Shell test, which had followed extensive seismic work in the area, showed oil and water after perforation and acidization, and was not produced beyond a short test period. Shell Oil Co., shortly after this well was drilled, retired from active operations in Michigan and O'Neal was reported to have leased a 5,800-acre drilling block in this district prior to starting the current interesting wildcat oil test.

If this potential Elmwood Township wildcat proves out commercially it will be the third Michigan field to be credited to Shell's seismograph work—one of which was discovered by Shell by drilling. The fields referred to are the Pinconning Dundee oil pool, Bay County, and the Arbela Dundee pool, Tuscola County. There are other so-called Shell "seismograph highs" in Michigan which are still seriously considered as potential areas for possible oil development.

MICHIGAN WILDCAT FAILURES

Clare County, Franklin Township: Scott Drilling Co. 1 Coon, SW SW SW 19-20n-3w, Stray 1,588 ft., dry, TD 1,610 ft.

Gladwin County, Butman Township: J. O. Mutch 1 Hutson, NE SE SE 3-20n-1w, Dundee 3,675 ft., dry, TD 3,790 ft.

Isabella County, Isabella Township: Roosevelt Oil & Refining Corp. 1 Isabella Gas Unit, N½ N½ NW, 18-15n-4w, Stray 1,464 ft., dry, TD 1,488 ft.

Mason County, Grant Township: Louis Rose 1 Rakoski, NW SW NE 34-20n-17w, Monroe 2,093 ft., dry, TD 2,149 ft.

Muskegon County, Dalton Township: James J. McGerry, Trustee, 1 Reigler, NW NW NW 19-11n-16w, Traverse 1,817 ft., dry, TD 1,875 ft.

Newaygo County, Lilly Township: Michigan Consolidated Gas Co. 1 State-Sippy et al, SE NW NW 36-16n-13w, Stray 891 ft., dry, TD 906 ft.

Ottawa County, Zeeland Township: Ottawa Developing Co. 1 Myaard, SW NW NE 36-5n-14w, Traverse 1,654 ft., dry, TD 1,675 ft.

Saginaw County, Jonesfield Township: Chartier Oil Co. 1 Howley, SW SE SW 9-12n-1w, Dundee 3,334 ft., dry, TD 3,406 ft.

St. Clair County, Wales Township: Arthur Etienne 1 Raymond, SE NE SE 14-6n-15e, Niagaran 3,277 ft., dry, TD 4,000 ft.

Van Buren County, Geneva Township: Cook Drilling Co. 1 Schabbel, NW NW NW 15-1s-16w, Traverse 1,078 ft., dry, TD 1,085 ft.

EASTERN TEXAS

Paluxy Sand Discovery Is Preparing for Tests

DALLAS.—W. M. Coats 1 P. H. Pewitt, Paluxy sand discovery in Titus County, 15 miles east of Talco, was moving in pumping equipment for potential tests. Total depth was 4,543 ft. Casing was set on bottom and perforated from 4,536 ft. to total depth. A 30-minute drill-stem test on the Paluxy from 4,493-4,543 ft. recov-

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Continental Oil Co. 1 Royall National Bank, Anderson County wildcat southeast of Tennessee Colony, had total depth at 10,086 ft. in sand and shale and was reaming at 10,025 ft. Cores from 10,047-86 ft. recovered siltstone, sandstone, and shale, with a very light gas odor in the sandstone.

Humble Oil & Refining Co. 1 J. T. Ellis, W. A. Dunnagan Survey, A-236, Anderson County, was reaming out, with total depth at 6,000 ft. Attempts to take side-wall failed to make reecovery.

E. W. Jarman 1 L. S. Hardegree, R. W. Berry Survey, A-109, new 5,500-ft. Woodbine wildcat 2 miles northwest of Ben Wheeler in Van Zandt County, was drilling below 3,110 ft. in shale. Electrical survey to 2,944 ft., placed the Pecan Gap at 2,720-2,830 ft.

F. R. Jackson 1 J. A. Durrett, D. Gilleland Survey, A-229, Woodbine wildcat in Wood County, had total depth at 4,806 ft. in sand and was running casing. Electrical survey was made to 4,795 ft. Operators reported a drilling break at 4,793-96 ft.; drillstem tested from 4,796-4,806 ft., with $\frac{3}{8}$ and $\frac{1}{4}$-in. chokes, and recovered 1,700 ft. of oil plus 10 ft. of heavily oil-cut mud in 18 minutes. Estimated gravity was 25°; flowing pressure was 750 psi., and shut-in pressure in 18 minutes was 1,950 psi.

EAST TEXAS (DISTRICTS 5, 6 AND 6-P) WILDCAT FAILURES

Grayson County: J. R. and Adam Seitz 1 Roy S. Baker, J. B. McAnair Sur., A-763, 1 mi. W Sherman, dry, TD 5,126 ft.

Kaufman County: P. G. Lake, Inc., 1 E. J. Fox, 1 mi. SW Cedarvale, D. F. Webb Sur., 2 mi. NE Walter Fair field, dry, TD 5,130 ft., sample top on Paluxy 5,117 ft., cored to 5,130 ft., no shows, elevation 430 ft.

Nacogdoches County: Humble Oil & Refining Co. 1 Mrs. Mary R. Saner, Charles Holmes Sur., 4 mi. NE Trawick, dry, TD 3,340 ft.

TEXAS GULF COAST

New Pay Is Opened Near South Gillock Production

HOUSTON. — Pan American Production Co. has opened a new pay approximately 2,000 ft. southeast of South Gillock field production, Galveston County, with the completion of 1 Scofield Community. The well flowed 239 bbl. of 37.8°-gravity oil daily through a 10/64-in. choke from perforations at 9,555-60 ft. Test is bottomed at 9,660 ft. Tubing pressure was 1,250 psi.

Jackson sand production has been opened on the north side of Copeland field, Polk County. A. O. Phillips 1 Armitage flowed 150 bbl. of 53°-gravity oil daily through $\frac{1}{8}$-in. choke with 490 psi. pressure on the tubing. This is a shallow-pay discovery for the field.

Humble Oil & Refining Co. 1 S. E. Miller, deep test on the South flank of Danbury field, flowed oil and salt water through perforations at 8,287-91 ft. The venture tested 35 bbl. of fluid per day. A previous test through perforations at 8,289-96 ft. recovered 1,080 ft. of oil-cut mud, 350 ft. of salt water, and 510 ft. of mud. Operators squeezed these perforations and reperforated from 8,280-88 ft. and on a test recovered 180 ft. of clean oil and 540 ft. of oil-cut mud. Operators will continued to test this wildcat, which is located in Henry Austin Survey 5, Abstract 13, Brazoria County.

Shell Oil Co. has completed 1 Fay Rouse, an extension for Provident City field, Lavaca County. Through perforations at 8,890-8,908 ft. the well flowed 92 bbl. of 48.5° distillate per day (nine of which were salt water) plus 4,590,000 cu. ft. of gas. Total depth of the well is 9,171 ft. and the top of the pay at 8,890 ft. This is a $1\frac{1}{4}$-mile southeast extension well to the field, being in the Aaron Monroe Survey, Abstract 304.

Stanolind Oil & Gas Co. has announced location for another test in the Texas tidelands. The well will be the A-2 State Lease 31685, and will be drilled from the same platform as its 1 State Lease 31700, discovery well in Galveston Bay. It is 660 ft. from the north line and 660 ft. from the east line of the northeast quarter of Tract 245. Projected depth of the test is 7,600 ft.

The 53 new locations on the Texas Gulf Coast include 11 wildcat starts, 1 each in Austin, Chambers, Harris, Liberty, Gonzales, Jackson, Lavaca, Live Oak, and Victoria counties, and 2 in Wharton County. There were two successful exploratory tests completed, one each in Bee and Galveston counties, while three were dry, one each in Jackson, Lavaca, and Wilson counties.

TEXAS GULF COAST (DISTRICTS 2 AND 3) SUCCESSFUL WILDCATS

Bee County: New oil pool—Skelly Oil Co. 1 G. W. Goree, Thomas Barton Sur., A-83, 2 mi. SW of Mineral, top sand 7,188 ft., TD 8,201 ft., perf. 7,199-202 ft., IP: 61 bbl. oil per day, 7/64-in. choke, GOR 5,344, TP 1,380 psi., CP 2,250 psi., 40.4° gravity.

Galveston County: New pay at South Gillock—Pan American Production Co. 1 Scofield Community, James Smith Sur., A-176, top sand 9,555 ft., TD 9,660 ft., perf. 9,555-60 ft., IP: 239 bbl. oil per day, 10/64-in. choke, GOR 680, TP 1,250 psi., 37.8° gravity.

TEXAS GULF COAST (DISTRICTS 2 AND 3) WILDCAT FAILURES

Jackson County: Edwin B. Cox & Jake L. Hamon 1 Ollie Lea Parr, F. G. Keller Sur., A-38, 15 mi. NW of Edna, dry, TD 5,016 ft.

Lavaca County: The Texas Co. A-2 Cora Russek, Louis Von Roeder Sur., 4 mi. NE of Hope gas field, dry, TD 3,712 ft.

Wilson County: S. M. Messer 1 J. H. Spruce, J. J. Berban Sur., 15 mi. NE of Poth, 9 mi. E of Floresville, dry, TD 2,803 ft.

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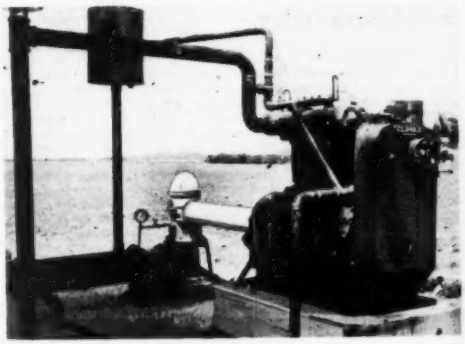

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APPALACHIAN FIELD

W. Va. Test Fails In Oriskany

PITTSBURGH—In Glade District, Webster County, West Virginia, Hope Natural Cas Co. completed an unsuccessful wildcat in No. 9227 West Virginia & Pittsburgh Railroad Co., elevation 2,512 ft., Oriskany sand 7,274-7,374 ft. with water at 7,300 ft. The total depth was 7,448 ft. in the Helderberg formation. This well will be plugged and abandoned. Dry Fork District, Tucker County, Cumberland & Allegheny Co. Co., N. 1-A-425 Jason Harman, elevation 3,304 ft., recorded the Benson sand 3,800 ft.; drilling is at 4,131 ft. New Interest District, Randolph County, South Penn Oil Co., No. 1 J. W. Isner, elevation 1,973 ft., encountered a bad hole at a depth of 6,020 ft. Elk District, Kanawha County, Columbian Carbon Co., No. 1-1130 M. L. Young was completed with gas gaging 1,163,000 cu. ft. after shot, which blew down to 253,000 cu. ft.; Corniferous lime 4,484 ft., Oriskany sand 4,996-5,063 ft., gas 5,023-5,026 ft.; total depth 5,100 ft.

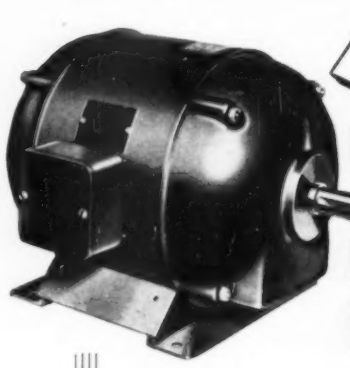
New locations reported in West Virginia were 12: Cove District, Barbour County; Otter District, Braxton County; Sheridan District, Calhoun County; Adkin District, McDowell County; Trap Hill District, Raleigh County; Grant and Murphy districts, Ritchie County; Curtis District, Roane County; Grant District, Wetzel County; and Williams District, Wood County.

Derry Township, Westmoreland County, Pennsylvania, Peoples Natural Gas Co., No. 4-3814 Camilla Giffen encountered a fishing job at 8,984 ft. Georges Township, Fayette County, Orville Eberly et al, No. 1 N. E. Murphy, elevation 2,560 ft., is drilling at 3,255 ft. Napier Township, Bedford County, South Penn et al-Snee & Eberly, No. 1 Jesse B. Miller, elevation 1,666 ft., is drilling at 4,813 ft.

New locations reported in Southwest Pennsylvania were eight: Boggs Township, Armstrong County; Redband Township, Clarion County; Jefferson and Whiteley townships, Greene County; Beaver Township, efferson County; Amwell Township, Washington County; and Allegheny and Bell Townships, Westmoreland County.

WEST VIRGINIA WILDCAT FAILURE

Webster County, Glade District, Webster County: Hope Natural Gas Co. No. 9227 West Virginia & Pittsburgh Railroad Co., elevation 2,512 ft., Dry, TD 7,448 ft.; Corniferous lime 7,120 ft., Chert 7,134 ft., Oriskany sand 7,274-7,374 ft., salt water at 7,300 ft. Completed in Helderberg formation.



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ROCKY MOUNTAIN

New Pay Is Opened in Bowes Field, Montana

DENVER—Northern Ordnance, Inc., of Oklahoma City swabbed 323 bbl. of oil in 21½ hours at its new-pay discovery at I Guertzgen, SW NW NE 2-31n-19e, in Bowes field, Blaine County, Montana. Production is from the Ellis between 3,378-3,410 ft. following a 750-gal. acid treatment. The well was drilled to 3,586 ft., total depth, in the Madison and found water in that formation. Drill-stem tests in the Lakota also showed water. The well has been completed for the initial swab period and further plans have not been announced for development in the field. Bowes field has produced gas from shallow formation since 1924. The present well was planned as a test to the Devonian and it is possible that the next well drilled by the company may be taken to that formation. As a result of the discovery there has been considerable leasing activity south of Bowes in Blaine and Hill counties.

Only mud was recovered on drill-stem tests in the Muddy sand at the Bridwell Oil Co.-Seaboard Oil Co. wildcat on the Meadow prospect northeast of Horsecreek field in Larimie County, Wyoming. The well is 1 Lewis, C SW SE 4-17n-67w, and the test was made between 9,702-38 ft. Slight staining was logged in the upper Muddy but no oil or gas was recovered on the test. The well is located on a seismic high and is projected as a test to Lakota at around 10,500 ft.

Interest of Rocky Mountain oil operators is again being attracted to the faulted area along the northeastern side of the Salt Basin of Colorado. Pure Oil Co. is now drilling below 4,270 ft., reportedly in white quartzitic sand, at its 1 Unit, C NE SW 1446 N-13w, on the Horsefly Unit, Montrose County, Colorado. The well has drilled a considerably thicker section of Mississippian and older beds than had been expected. The well is a tight hole with no release of information below 2,000 ft. Shows of oil were encountered between 1,400 and 2,000 ft., possibly in Jurassic. It is considered probable that the well is near granite at its present depth and that Pure will plug back and test shows prior to completion. An extensive lease play extending over 100 miles northwest of Horsefly was conducted 2 years ago, with the majority of major operators actively leasing. Continental Oil Co., J. M. Huber Corp., and Lion Oil Co. are now unitizing their Nucla structure 8 miles northwest of Horsefly and plan a wildcat as soon as unitization is completed.

Oil activity in western Nebraska was considerably cooled this week with announcement by The Ohio Oil Co. of failure in the first Dakota sand of two wells in the Gurley area, Cheyenne County. The wells are 1 Caywood, NE SW SW 1-15n-49w, which is suspended at 4,427 ft., total

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depth, and 1 Stephens, NE SE SW 2-15n-49w, which went to 4,431 ft., total depth. The wells are northeast and northwest offsets to Ohio's discovery well which was recently completed pumping 225 bbl. of oil daily from the first Dakota. Inasmuch as the wells were nearly level structurally with Ohio's discovery it is considered that pool limits are nearly defined by these wells. Ohio now has two producing oil wells, two failures, and one well being worked over in an effort to shut off water. There have been three other dry holes drilled in the general area. In th meantime various major and independent operators are still actively leasing in western Nebraska. Superior Oil Co., Magnolia Petroleum Corp., British-American Oil Producing Co., The Texas Co., Sohio Petroleum Co., Cities Service Oil Co., and others have blocks in the area.

New locations.—There were 33 new locations with 23 in Wyoming, 3 each in Montana and Utah, 2 in Colorado, and 1 each in northern New Mexico and western Nebraska. In Wyoming, Amerada Petroleum Corp. made location for two wildcats on the east side of the Powder River Basin. Both 1 Unit, C SW SW 23-53l8-69w, on the Bertha Unit, and 1 Unit, C NW SW 14-52n-69w, at East Adon, will test Lakota at around 6,500 ft. The Texas Co.'s 1 Unit, NE SW SW 24-55n-68w, on the Stronger Unit is also a Lakota test in the same area. There were a number of new wells started in the Fiddler Creek-Hay Creek area following excellent recent completions.

Completions.—There were 19 completions, with 5 wildcat completions during the week. The only successful wildcat completion was Southern Union Producing Co.'s gas discovery in the Glade area, San Juan County, New Mexico. The well gaged 5,000,000 cu. ft. of gas daily from Point Lookout sand. At Pine Ridge, Utah, Tide Water Associated Oil Co. and Mohawk Petroleum Corp. abandoned their wildcat in Mississippian at 3,508 ft., total depth.

WYOMING WILDCAT FAILURE

Ramshorn, Teton County: George G. Travis 1 Govt., C SW SW 5-43n-114w, 590 TD; plugged and abandoned, lost hole. Dinwoody 130, Phosphoria 408.

COLORADO WILDCAT FAILURE

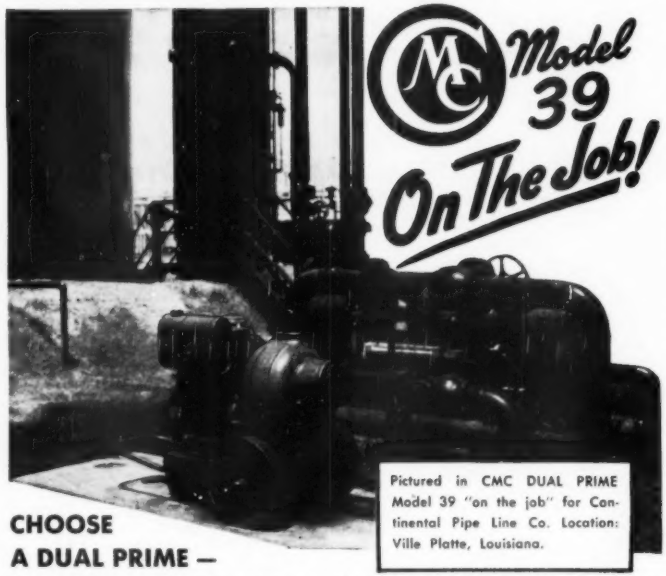
Wildcat, Yuma County: Ambassador Oil Co. 1 State, NW¼ 24-4s-48w, 3,650 TD, plugged and abandoned.

UTAH WILDCAT FAILURE

Pine Ridge, Uintah County: Tide Water Associated-Mohawk 1-38-7, SW SW SE 7-3s-20e (330 N & E of S¼c), 3,508 TD; plugged and abandoned. Park City 730, Weber 876, Morgan 1,630, Mississippi Black Shale 2,588, Mississippi lime 2,735.

NEW MEXICO SUCCESSFUL WILDCAT

Glade, San Juan County: Southern Union Prod. 1 Richardson, NW SE SE 10-31n-12w, 5,330 TD; flowed 5,000 M.c.f. gas per day from Point Lookout; Point Lookout 5,033.



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OKLAHOMA

Oil Producer Completed In Grady County Wildcat

R. J. CARAWAY has opened a new pool in Grady County at his 1 Drewry, C SE SE 33-3n-7w, which has been completed pumping 54 bbl. of 28.5° oil in 24 hours from a sand at 2,788-2,805 ft. Originally drilled to a total depth of 9,300 ft., the hole was plugged back to 2,805 ft. and 7-in. casing cemented at 2,786 ft. The well made 100 bbl. the first 24 hours, 71 bbl. the second 24 hours, and then settled to its present daily production. Located 3 miles north of Marlow, it is 4 miles from the nearest production, the Northwest Marlow pool, 4 miles to the west.

Sohio Petroleum Co. 1 Tims, NE NE NW 32-6s-2e, 2 miles west and a little south of the North Marietta pool in Love County, recovered 75 ft. of 37.5° oil and 91 ft. of gas-cut mud in a 60-minute drill-stem test of Pennsylvanian sand at 6,278-93 ft., and looks like the discovery of another producing area. Pressure built up to 1,700 psi within 15 minutes after the tool was closed.

The first confirmation test for the recently opened Southeast Keyes pool in Cimarron County, in the Panhandle, flowed an estimated 5,000,000 cu. ft. of gas per day in initial tests. The well, Bay Petroleum Co. 2 Frank Parkes, NE SW SW 34-4n-8ECM, is a 40-acre, diagonally southwest location from the discovery well, 1 Frank Parkes, which was completed flowing approximately 50 bbl. of oil per day from the same pay zone, the Keyes sand (basal Pennsylvanian). The second well topped the sand at 4,806 ft. and was drilled to 4,924 ft. in Mississippian, topped at 4,914 ft.

The second well for the new Booch sand pool being opened by Coronado Oil Co. 4 miles north of Atwood in Hughes County has reached the pay zone and is showing for possible producer after finding good saturation in cores from 2,844 to 2,864 ft. Top of the sand is 2,841 ft. The well is a southeast diagonal offset to the discovery well, 1 Stephenson, which is being placed on the pump after swabbing at the rate of 75 bbl. per day from the sand, topped at 2,800 ft. The confirmation well has casing cemented on top the sand and is preparing to drill out plug to test.

A half mile south of the limits of shallow sand production of the Hewitt pool, Carter County, George D. Blaylock 1 Dillard, SW NW SW 27-4s-2w, is reported to have flowed at the rate of 50 bbl. of oil per hour in a drill-stem test of a sand at 3,099-3,130 ft. and to have recovered an estimated 2,000 ft. of oil in a second test of the same pay taking in an interval at 3,107-30 ft. Since the well is being drilled "tight," the information is unconfirmed. The pay zone is reported to be the First

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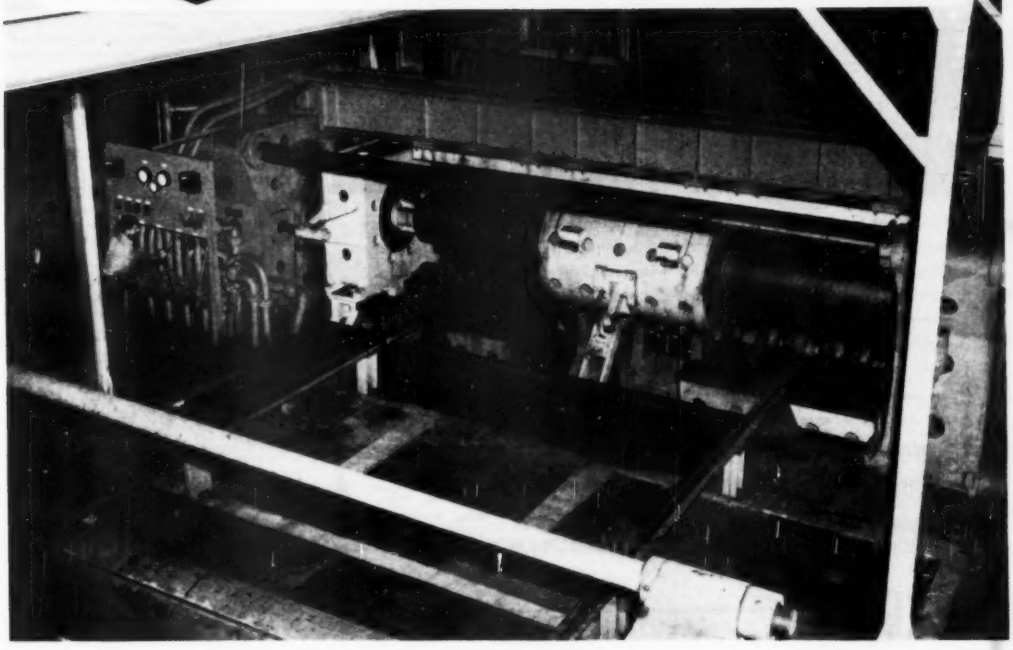

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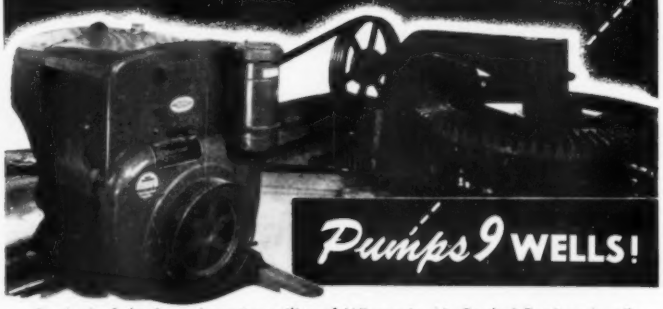

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Lone Grove sand (Pennsylvanian). Hole is being deepened.

OKLAHOMA SUCCESSFUL WILDCATS

Beckham County: Union Producing Co. 1-A Music, C NE SW 24-10n-21w, IP 157 bbl., conglomerate, 9,270-9,315 ft., TD 13,212 ft.

Hughes County: Davidor & Davidor 1 Meadows, NE NE NE 4-8n-10e, gas, Gilcrease, 2,702-11 ft., TD 3,142 ft.

McClain County: Cities Service Oil Co. 1 Dacus, NW NW SW 29-5n-4w, IP 212 bbl., Chimney Hill, 10,254-10,314 ft., TD 11,760 ft. (Well originally completed in first Bromide).

Pittsburgh County: Intex Oil Co. 1 Welsh unit, C NW SW 35-6n-15e, gas, sand, 1,164-85 ft., TD 2,010 ft.

Stephens County: Skelly Oil Co. 1 Brittain, SE SW NE 5-1s-5w, IP 20 bbl., Springer sand, 4,234-80 ft., TD 7,042 ft.

OKLAHOMA WILDCAT FAILURES

Carter County: Lewis 1 Lamb, SE NE NW 12-5s-2w, dry, TD 5,047 ft.

Grant County: Eason Oil Co. et al 1 Barrett, NW NW NE 25-29n-4w, dry, TD 5,075 ft.

Lincoln County: Fordee-Rhoades 2 Hinds and Jergins, SW SW SW 9-12n-6e, dry, 3,268 ft.

Okfuskee County: Foster 1 Replogle, NE NW SW 23-13n-8e, dry, TD 3,547 ft.

Okmulgee County: Wadsworth 1 McCallister, SE NE NW 6-14n-11e, dry, 3,107 ft.

Payne County: Woods Drilling Co. 1 Murphy, SE SE SW 17-18n-1e, dry, TD 5,393 ft.

Seminole County: King 1 Adams, NW SE SE 12-10n-7e, dry, TD 3,576 ft.

MISSISSIPPI

Stanley Sand Prospect Near Laurel Is on Test

JACKSON.—Approximately 6 miles north of Laurel, Miss., Red Wing Drilling Co. et al is preparing to run casing to test prospective gas-condensate production in the Stanley sand in the 1 Torry Smith. Cores and Schlumberger indicated salt water in the Tuscaloosa Massive, which was picked up at 6,853 ft. Total depth of this venture is 6,952 ft.

In Adams County, Mississippi, approximately 4½ miles northwest of Ellisile field, Humble Oil & Refining Co. 1 Laura Butler, 15-5n-3w, flowed at the rate of 387 bbl. of fluid per day, being 99 per cent salt water, 1 per cent oil, and 38,000 cu. ft. of gas. The well is now shut in and rig is being moved off location.

At Russum field, Jefferson County, Mississippi, Stanolind Oil & Gas Co. 1 J. B. Dockery, discovery well for the field, has had pump installed, but has not been pumped enough as yet to give any indication of what the well will produce.

The California Co. 1 J. W. Bass Unit, 19-5n-4e, Bude field, Franklin County, is preparing to test perforations at 10,948-70 ft. opposite Lower Tuscaloosa sand. Cores and Schlumberger have indicated 24 or 25 ft. net oil, which is the best sand section encountered in the field to date.

Cities Service Oil Co. has staked location for the 1 Board of Supervisors, wildcat to be drilled in 16-6n-16w, Jefferson Davis County, Mississippi. State permit has not been issued as yet.

A Wilcox test has been spudded 3½ miles northeast of Ellisile field, Adams County, by Dan L. Reynolds. The test is the 1 Robert E. Coffman et al.

The 11 new locations in Mississippi include 2 wildcat starts, 1 each in Adams and Jefferson Davis counties. There were two dry exploratory tests completed during the week, one each in Lamar and Smith counties.

GEORGIA WILDCAT FAILURE

Houston County: Tricon Minerals, Inc., 1

H. B. Gilbert, Fourteenth Land District, Lot 266, dry, TD 1,699 ft.

MISSISSIPPI WILDCAT FAILURES

Lamar County: Union Producing Co. 1 Pinelands Minerals, Inc., 30-3n-16w, dry, TD 8,046 ft.

Smith County: Carter Oil Co. 1 Ira Mayfield, 11-10n-14w, dry, TD 8,503 ft.

OHIO, KENTUCKY

Good Gas Shows Found In Several New Wells

COLUMBUS.—Sturm Heirs 5 D. O. Petty, Section 20, Reading Township, Perry County, an offset oil location, found 1,300,000 cu. ft. gas with a show of oil, natural, in the Clinton at 2,936-76 ft. The well is in the south center part of the township near old production, and no report of it being shot has been received.

Ed Obermiller 1 John Hood, Lot 53, Medina County, came in at 311,000 cu. ft. natural, with 1,060 lb. rock pressure. This is the first well drilled in the area in recent years. Clinton sand reported at 3,370-78 ft.

McGrath et al completed a small well in Parma Township, Cuyahoga County, on J. A. Smolin, Lot 41. Red Clinton at 3,145-88 ft. showed 260,000 cu. ft., natural, and 700,000 cu. ft. after shot.

Ohio Fuel 1 John Kline, Section 20, Congress Township, Wayne County, found 210,000 cu. ft. in the Newburg at 2,715-96 ft., which made 305,000 cu. ft. and some oil after acidizing.

Ditch & Gerig 3 Renke, Section 2, Homer Township, Medina County, found 744,000 cu. ft. in the Newburg, but it blew down and the well is being drilled to the Clinton.

Perry, Knox, and Washington counties reported 5 locations each and 9 other counties reported an additional 12. Cambridge field led in completions with 8 out of a total of 27.

OHIO WILDCAT FAILURE

Stark County, Bethlehem Township: M. B. Belden Co. 1 Clarence Beitzel, Sec. 28, Clinton 4,343-4,456 ft., TD 4,702 ft.

EASTERN KENTUCKY

ASHLAND.—In Bath County, 25-T-71 about 1 mile east of the town of Olympia, the first well drilled in this old pool area, has ended in failure. R. B. Tamblyn et al 1 Pipenbrink, finished at a total depth of 317 ft. in Upper Ordovician lime with no shows recorded. Well was an attempt to extend Olympia pool production.

In Johnson County 19-R-79 Ashland Oil & Refining Co. 8 Wallace Williams is fishing for sand pump at a depth of 5,670 ft. Upon completion of fishing job drilling will be resumed.

In Johnson County and some miles north of the above test Ashland Oil & Refining Co. is drilling at 350 ft. on 61 Sanford Lyons, another test in the midst of other old producers in the Martha Pool on Laurel Creek Dome.

In western Lewis County 4-Y-72 H. P. Purnell et al are drilling at 1,098 ft. on 1 C. F. Ferguson, a rank wildcat for the county. Drilling is now progressing in the High Bridge series.

WESTERN KENTUCKY

OWENSBORO.—Although being drilled deeper for a look at lower horizons, Nash Redwine and associates 1 Bowers-Henry Walker, 6-Q-22, a wildcat on Diamond Island, in the Ohio River, about a mile north of the Geneva pool, Henderson County, has given indications of possible production in Tar Springs sand. A drill-stem test of this sand at 1,955-67 ft. gave a recovery of 10 ft. of clean oil and 50 ft. of oil-cut mud. Indicated bottom-hole pressure was 650 psi. Tool was open 60 minutes. The location is about 10 miles southeast of Mt. Vernon, Ind.

A second producing zone for the new Caney Mound East pool in 13-P-20, Union County, is being opened by Delta Drilling Co. 2 Walker heirs, which swabbed at the rate of 7 bbl. per hour from McClosky lime at 2,590-96 ft. following an acid treatment of 3,000 gal. The discovery well, 1 Walker heirs, completed late in August as a 364-bbl. pumper, is producing from the O'Hara at 2,512-23 ft.

I. W. Hartman and Calvert-Willis, Inc., 2 Meredith, 11-P-28, a location north of 1 Meredith, discovery well of the new producing area opened early in September, on the east side of Wabash Island, 4 miles west of Uniontown, Union County, has been completed as a 16-bbl. pumper in Biehl sand at 1,550-60 ft. and 1,572-76 ft. Hole was plugged back from a total depth of 2,350 ft., where it failed to make a well in the Cypress sand, the producing horizon of the discovery well.

WESTERN KENTUCKY WILDCAT FAILURES

Henderson County: George S. Engle 1 J. Reichert Estate, NE NW SE 24-Q-22, dry, TD 2,699 ft.

Union County: John Sallee 1 J. F. McKinney, NW NW NW 20-O-18, dry, TD 2,700 ft.

INDIANA

EVANSVILLE.—Gilliam Drilling Co. 1 Alured Lammey, SE SE NW 20-10n-8w, a diagonal northwest offset to the discovery well of the recently opened Blackhawk pool in Vigo County, pumped 100 bbl. per day and has been completed as the second confirmation producer. Previously, the pool was extended to the northeast. The Devonian lime pay zone of the pool is pro-

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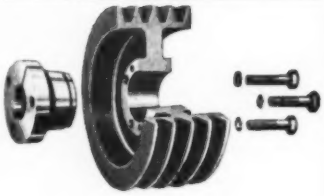

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ductive in the new well at 1,876-79 ft. and 1,881-88 ft. The discovery well, 1 Huntwork, also pumping 100 bbl. daily, had the pay at 1,847-49 ft. and 1,855-1,927 ft.

A half-mile southeastward extension of production is indicated at Gilliam Drilling Co. 2 Huntwork, SE SE SE 20-10n-8w, where testing of Devonian at 1,851-61 ft. is under way following a 1,000-gal. acid treatment.

John Zanetis 1 Ida B. Doty, W½ SW NE 29-2n-8w, Knox County, is opening a new oil producing pay zone in the old Monroe City gas area. It is swabbing 1½ bbl. of oil natural from Salem lime at 1,814-46 ft. with bottom of the hole at 1,866 ft. It is southeast of a small McClosky lime discovery well recently completed by the same operator.

INDIANA WILDCAT FAILURES

Clay County: W. C. Cook, Jr., 1 Acree & Strachan, E½ NE SW 30-12n-7w, dry, TD 1,620 ft.

Sullivan County: H. M. Gray 1 C. M. McKinney, NW NE SE 5-8n-10w, dry, TD 2,652 ft.

LA.-ARK.

Wilcox Discovery Has Good Flowing Potential

SHREVEPORT.—Marine Oil Co. 1 Farrar, NE SW 19-5n-6e, completed as a Wilcox discovery for a flowing potential of 168 bbl. of 37°-gravity oil a day. The flow was through 11/64-in. tubing choke, from perforations at 5,855-57 ft. Tubing pressure was 275 psi. Location is 7 miles northeast of Saline Lake field, in Catahoula Parish.

Five miles southeast of Saline Lake field, Hunt Oil Co. 5 Louisiana Delta, SW NE 23-4n-5e, resumed operations after months of delay due to high water. Total depth was 10,650 ft., plugged back to the Wilcox at 6,080 ft. New perforations were made from 5,835-40 ft., and the well pumped 45 bbl. of oil in 4 hours, plus an unestimated amount of salt water. It pumped off at the end of the 4 hours. Hunt Oil Co. 16 Louisiana Delta, 27-4n-5e, 6 miles southeast of Saline Lake field, was dry at 7,600 ft. Last drill-stem test, from 5,832-40 ft., open 35 minutes, recovered 1,730 ft. of salt water with no shows.

In Sicily Island field, Catahoula Parish, Interstate Natural Gas Co. 1 Tensas Delta, 11-9n-7e, ran 5½-in. casing to around 8,520 ft. and started testing. Total depth was 8,602 ft. in sand. According to one report, perforations from 8,557-66 ft. yielded a flow of 140 bbl. of 40°-gravity oil a day, through 7/64-in. choke, under tubing pressure of 1,200 psi. Gas-oil ratio was 700. At last report it was shut in for completion potential.

Failure for the new Bossier City field, Bossier Parish, was Fort Worth Royalty Co. 1 C. Woodward, SE SW 23-18n-13w. Total depth was 5,640 ft., in the Travis Peak. A drill-stem test from 5,580-5,604 ft., using ¼-in. chokes and open 19 minutes, recovered 60 ft. of salt water plus 30 ft. of gas-cut mud. Bottom-hole flowing pressure was 900 psi.

C. H. Murphy 1 Crystal Oil & Refining Corp., 14-21n-12w, Bossier Parish, was drilling at 7,615 ft., with no shows reported. Sample top on the Travis Peak was 6,376 ft., on elevation of 240 ft.

Union Producing Co. 1 Section 13 Unit, 13-17n-12w, cored nonporous sand with faint gas odor from 7,950-8,000 ft. A drill-stem test from 7,982-8,000 ft., identified as the "D" sand of the Cotton Valley, recovered 8 ft. of distillate, and 15 ft. of distillate-cut mud in 12 minutes. Maximum tubing pressure was 150 psi. A core from 8,000-50 ft. recovered 9 ft. of slightly porous sand with gas odor, 37 ft. of nonporous sand with no shows, and 4 ft. of siltstone. From 8,050-8,100 ft. the recovery was shaly siltstone and black, limy shale with no shows. Drilling continued below 8,140 ft.

Ohio Oil Co. et al 1 Martin, 3-22n-7w,

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Claiborne Parish, was drilling below 8,603 ft.

In Tensas Parish, Peterson Drilling Co. 1 H. C. McKinney, 11-13n-10e, had total depth at 7,966 ft., in the upper Glen Rose. Operators ran electrical log, then started running 5½-in. casing to test the Basal sand of the Tuscaloosa. The section to be tested was not disclosed.

NORTH LOUISIANA WILDCAT FAILURES

Catahoula Parish: Hunt Oil Co. 16 Louisiana Delta, NW NW 27-4n-5e, dry, TD 7,600 ft., Wilcox 4,579 ft., oil show 5,834-35 ft., elevation 52 ft.

Concordia Parish: Hunt Oil Co. 1 John Dale, Jr., SE NW 8-6n-8e, dry, TD 10,261 ft., Wilcox 4,029 ft., Midway 7,225 ft., Arkadelphia 8,170 ft., Austin 9,079 ft., Eagleford 9,307 ft., Marine Tuscaloosa 9,754 ft., Pilot sand 10,075-104 ft., Massive sand not present, lower Cretaceous 10,876 ft., elevation 59 ft.

Southeastern Drilling Co. 1 J. M. Hughes, 50-8n-10e, dry, TD 9,404 ft., Wilcox 3,633 ft., Midway 6,805 ft., Cretaceous 7,810 ft., Austin 8,520-8,805 ft., Eagleford 8,805 ft., Tuscaloosa 8,988 ft., Marine Tuscaloosa 9,288 ft., elevation 70 ft., did not reach Massive sand in the Tuscaloosa, probable top around 9,620 ft.

Lincoln Parish: Southwest Gas Producing Co. 1 J. L. Liggin, NE NE SW 9-20n-2w, dry, TD 8,819 ft., Midway 1,390 ft., Arkadelphia 2,010 ft., porosity 2,040 ft., Massive anhydrite 3,512-3,708 ft., Travis Peak 4,995 ft., Cotton Valley 7,480 ft., Bodcaw 8,081 ft., McFearin sand 8,375 ft. had gas-distillate odor, DST failed, did not retest, elevation 145 ft.

Union County: McCain & Holloway 1 C. D. Holloway, NE NE SE 15-23n-1w, dry, TD 2,287 ft., Midway 1,533 ft., Arkadelphia 2,082 ft., Nacatoch 2,177 ft., sand 2,236 ft., elevation 233 ft.

SOUTHWEST TEXAS

Oil Production Confirmed In New London Gin Field

CORPUS CHRISTI.—Oil production in the new London Gin field has been confirmed with completion of Grace Oil Co. 1 C. N. Cooke, 10 miles south of Corpus Christi, Nueces County. The well flowed 107 bbl. of 32 -gravity oil per day through a 9 64-in. choke with 200 psi. pressure on the tubing. Production is through perforations at 4,470-76 ft.

Gasoline Production Corp., Ralph Rowden & Dale H. Rowden 1 John P. Akin-State of Texas promises to open a new field 11½ miles southwest of Freer, Duval County. Drill-stem test was run at 2,155-63 ft. and recovery was 1,600 ft. of pipeline oil and 300 ft. of oily mud in 1 hour, through ¼-in. choke. The well will be swabbed in and potential taken as soon as tanks are built.

A southwest extension to West Charlotte field in Frio County has been made with completion of Lewis Oil Co. 1 D-1 Oppenheimer & Lang. Through ⅛-in. choke the well flowed 29 bbl. of 29.6 -gravity oil per day with tubing pressure of 500 psi. and casing pressure of 1,100 psi. Total depth of the test is 5,580 ft. and completion was made through open hole from 5,557-80 ft.

Luling Oil & Gas Co. 1 D. Whetstone, San Patricio County wildcat in Section 116, Welder and Odem Subdivision, 1 mile southwest of Odem, was drilling ahead at 5,500 ft. after drill-stem test at 5,427-31 ft. recovered 390 ft. of oily salt water.

The second oiler for Salt Lake field, Aransas County, has been completed by Nueve Oil Co. 1 F. G. Huffman. On potential test the well gaged 153 bbl. of 42 -gravity oil through 5 32-in. choke. Total depth of the venture is 7,278 ft. and production is through perforations at 7,168-78 ft. Tubing pressure is 650 psi., and casing pressure is 1,150 psi.

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The 40 new locations in Southwest Texas include 14 wildcat starts, 1 each in Bastrop, Frio, Travis, Brooks, Jim Wells, and Nueces counties, 2 in Webb County, and 3 each in Williamson and Duval counties. There were no successful exploratory wells completed. Fourteen were dry, one each in Atascosa, Caldwell, Frio, Milam, Brooks, Hidalgo, and Starr counties, two each in McMullen and Webb counties, and three in San Patricio County.

SOUTHWEST TEXAS (DISTRICTS 1 AND 4) SUCCESSFUL WILDCATS

Atascosa County: Newman Bros. and E. W. Gill et al 1 Joe Mauch, J. Poitevent Sur. 1, A-707, 9 mi. NE of Campbellton, 3 mi. SW of Weigang field, dry, TD 4,080 ft.

Brooks County: L. M. Lockhart 1 Enrique L. Villareal, La Encantado Grant, 10 mi. W of Encino, 6 mi. SW of Rachal, dry, TD 7,905 ft.

Caldwell County: Tarpon Oil & Gas Co. 1 Tyre H. Brown, Dorothy Benton Sur., 5 mi. NE of Lockhart, dry, TD 1,740 ft.

Frio County: Newman Bros. & Alaska Steamship Co. A-1 Oppenheimer & Lang, Paul A. Dermigs Sur. 208, A-288, 12 mi. E and little N of Pearsall, 3 mi. SW of Schattel, dry, TD 4,149 ft.

Hidalgo County: Continental Oil Co. 1 De Los Thompson, Block 202, Sec. 181, West tr. subd. of Llano Grande Grant, 3 mi. NW of Weslaco, dry, TD 11,021 ft.

McMullen County: Harold K. Boysen D-1 Hagist Ranch, Inc., H&TC Sur., 14 mi. N of Freer, dry, TD 2,433 ft.

Utah Oil Corp. 1 Nueces Land & Livestock Co., I&GN Sur. 1, A-278, dry, TD 2,450 ft.

Milam County: Buda Oil Co. 1 J. F. Coffield, J. J. Acosta Grant, 17 mi. NW of Rockdale, dry, TD 2,113 ft.

San Patricio County: Irene Oil & Gas Co. 1 B. F. Collins, Ed J. McGloin Sur., 2 mi. NW of Mathis, dry, TD 4,728 ft.

Curtis Singleton Drilling Co. 1 J. Shary, Geo. H. Paul Subd., 4 mi. SE of Sinton, dry, TD 5,604 ft.

Southern Minerals Corp. 1 Cora I. Hunt, Gregory townsite, dry, TD 6,520 ft.

Starr County: Humble Oil & Refining Co. 1 Dario Olivares, Santa Cruz Grant, 2.3 mi. S of Delmita, dry, TD 8,292 ft.

Webb County: W. F. Calohan & R. F. Campbell 1 Yeager-Armstrong et al, Las Animas Grant, 14 mi. from Mirando, dry, TD 3,510 ft.

Morris Cannan 1 Lee Adami, Sur. 9, A-881, 25 mi. NW of Freer, dry, TD 1,064 ft.

ILLINOIS

New Oil Pool Indicated by Christian County Wildcat

MATTOON.—What appears to be another new pool for Christian County has been discovered by Paul Doran in his 1 Earl Heater, NW NE NW 15-14n-3w. In a drill-stem test at 1,800-14 ft. with bottom in Devonian lime, topped at 1,812 ft., the well made a good showing of gas, and 30 ft. of clean oil and 245 ft. of oil and gas-cut mud was recovered without indication of any water. Bottom hole pressure was 600 psi. Operators have cemented 5½-in. casing at 1,793 ft.

The location is in a rank wildcat area 9 miles northwest of Taylorville. Nearest production is in the Mt. Auburn pool, about 8 miles northeast.

A ¾-mile eastward extension of production of the Louden pool, Fayette County, has been established by W. L. Beldon in his 1 Grames, SW NE NW 25-8n-3e, which has been completed pumping 130 bbl. of oil daily from Cypress sand at 1,492-1,512 ft. with open hole from 1,490 ft. to total depth at 1,528 ft. A 10-acre southwest diagonal offset, 1-A Hudson, also is showing for a producer with the sand at 1,541-60 ft. It is swabbing 4 bbl. of oil per hour. The new area is about 6 miles north of St. Elmo.

About 1½ mile southwest of the Beldon discovery, Reynolds & Henson are opening another Louden extension area at their 1 Kuppels, SE SE SE 35-8n-3e, which recovered 400 ft. of clean oil and 50 ft. of oil-cut mud in a 60-minute drill-stem test of Cypress sand at 1,601-12 ft. Casing is being run for completion.

Collins Brothers Oil Co. 1-B Martha Flower, NW SE SW 27-1s-9e, a half mile northeast of production of the Half Moon pool, Wayne County, and about the same distance south of the same company's 1 Flower extension well, flowed clean oil in

(Continued on page 393)

Statement of the Ownership, Management, Etc., of
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S. H. ROURKE,
Business Manager.

Sworn to and subscribed before me this 27th day of September, 1949.

JOHN P. GALLAGHER,
Notary Public.

My commission expires March 1, 1951

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Global Oil Policy Urged at Meeting

(Continued from page 154)

retarded because widespread deep drilling failed to find oil. He said, however, that it is probable that there is oil in anticlinal or stratigraphic traps in several parts of the state.

"Modern Methods in Petroleum Exploration" by Godfrey F. Kaufmann, of Standard Vacuum Oil Co., emphasized that in petroleum exploration it is important to study not only stratigraphy but the tectonics of the large geologic features. He outlined the "under thrust" theory for the origin of geosynclines and geoanticlines, and discussed modern geological and geophysical techniques, both surface and subsurface.

Refining Problems Discussed

"It is apparent that the petroleum industry's chemists and engineers must further devise newer methods to economically and fully refine heavier and higher-sulfur crudes remaining as reserves, as well as to produce acceptable synthetic fuels from undeveloped potential sources such as oil shale and coal." This statement was made by C. K. Viland, general supervisor, research and development department, Tide Water Associated Oil Co., in his address before a refining conference. In reviewing development and application of modern processes, he pointed out the size of the industrial research program—"100 milion dollars represents the oil industry's share."

H. M. Schmitt of Brown Instrument Co., described all types of control instruments in use in the oil industry, saying "the petroleum industry pioneered and is still the leader in large-scale continuous-processing operations." Included in his address were descriptions of top-tower temperature control, stabilizer instrumentation, instrumentation for a narrow-boiling-range column, and fluid catalytic cracking instrumentation.

"Ethylene Production by Thermal Cracking of Propane-Ethane Mixtures" by C. K. Buell and L. J. Weber of Phillips Petroleum Co. described the formation of ethylene, used in a wide variety of petroleum-derived chemical products, and fuels and lubricants. Design of high-temperature gas-cracking furnaces, operating data, and solution of many operating problems involved in the production of ethylene and from a propane-ethane-methane mixture were discussed.

Edward W. Isom, vice president of Sinclair Refining Co., presented a review of the cracking industry. Early recognition of the superiority of cracked over straight-run gasoline as a motor fuel, he said, made the cracking process "vital not only in terms of gasoline quantity but also in terms of quality." Development of pyrolytic cracking from batch processes, through the continuous "heating without cracking and cracking without heating" processes and vapor-phase cracking with and without catalysis was discussed.

Catalytic dehydrogenation of butane to produce butadiene was described by H. L. Hays and Edward Dolezal of Phillips Chemical Co. in "The Commercial Dehydrogenation of Normal Butane." The paper discussed design and operation of equipment used in the process.

Petroleum Production Conferences

State regulation of petroleum production for conservation measures is preferable to control by one central federal body because each state can adequately provide the needed controls and because each state, being nearer to the problems involved, can more quickly arrive at just and equitable solutions. This is the essence of an address made by D. V. Carter of Magnolia Petroleum Co. before a production-group meeting.

"More is known of what to do than is being practiced," he said. "One important reason for this condition is legal—the fear of punitive measures from state and federal governments on the grounds of antitrust. . . . For it is a fact that unit operation of common reservoirs, and to a lesser extent cooperative projects, is absolutely necessary if the engineer and his plans are to prevail to the end that maximum recovery is to be obtained and thus aid and benefit all concerned."

Carter added: "The fact is that the petroleum engineer and all those in related research possess the knowledge to better the rate of recovery as well as the ultimate recovery in a majority of cases if legislative inertia can be overcome, and the understanding and appreciation of management and governmental agency quickened and stimulated."

Secondary Recovery Discussed

Two papers were presented on secondary recovery at the conference: "Secondary Recovery of Petroleum" by Paul D. Torrey, and "The Valuation of Oil Properties for Secondary Recovery," by R. C. Earlougher. Torrey's paper considered the history of secondary operations in the United States, the various methods that have been employed to increase recovery from oil fields, and secondary oil reserves in the United States. Reserves, he said, "are estimated currently to be in excess of 7 billion barrels, but the author is willing to venture the guess that the physically recoverable secondary oil reserve of the nation may be as much as twice this figure."

Earlougher's paper reviewed the principal methods of secondary recovery and described information necessary and the study and steps required to obtain such information. He numbered the considerations necessary in an economic survey of a water flood, and presented an approximate rate of recovery for a given rate of water injection.

Another of the papers presented to the production audience was titled "The Drilling, Producing, and Valuation of Distillate Fields," given by W. E. Brown, chief engineer of Midstates Oil Co. The address included a description of condensate field characteristics, recovery mechanics, and reserve and recovery valuations.

Geophysical Conferences

A review of the development and application of the reflection and refraction seismograph was presented to the geophysical group by C. H. Green of Geophysical Service, Inc., who predicted improvements in the field must come from research—both in development of equipment and in fundamental analysis.

D. H. Clewell of Magnolia Petroleum Co. described research projects now being actively carried on by industry and universities. He covered such things as instrumentation, field techniques, and record analysis. "Most research that has been done in the past," he said, "has been concentrated on recording instruments, and research on the generation and propagation of seismic signals has been neglected."

The part that speculation plays in interpretation of geophysical data was discussed by R. Clare Coffin, Stanolind Oil & Gas Co. H. G. Doll and Maurice Martin of Schlumberger Well Surveying Corp., discussed improvements and methods of electric logging new to geophysical technique. Sigmund Hammer of Gulf Research & Development Co. presented a paper titled "Recent Developments in Gravity Prospecting," in which he discussed new techniques in methods, interpretations, instrumentation, and operations in the gravity method.

Crude-Oil Allowables Are Raised in Oklahoma, Kansas

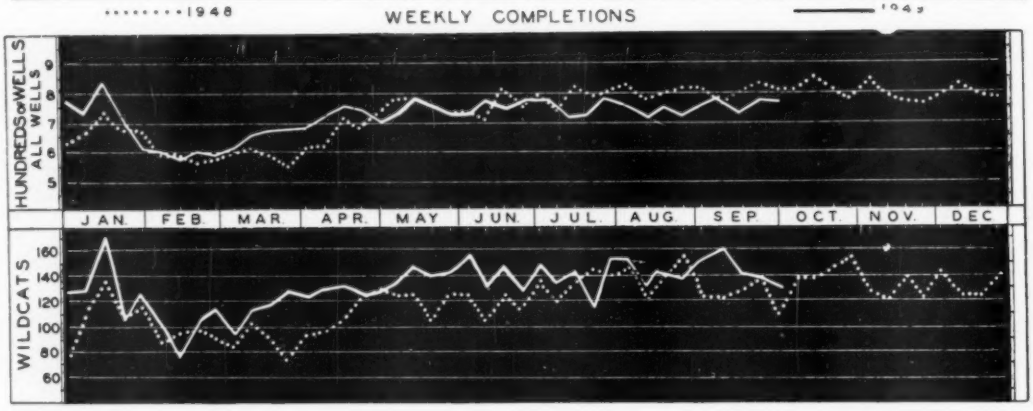
October crude-oil production allowable for Oklahoma has been increased 50,000 bbl. daily, to 410,000 bbl. by the state Corporation Commission. This figure meets the U. S. Bureau of Mines' estimate for October demands. Kansas Corporation Commission also raised allowables in that state for October by 15,000 bbl. daily.

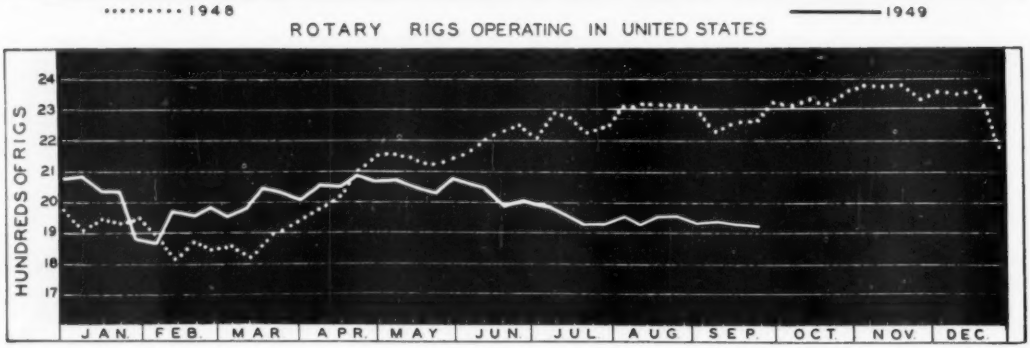
Kansas' production for October has been set at 275,000 bbl. daily maximum. The current raise follows a general trend in the state of increasing output of crude. August's rate was 5,000 bbl. daily over July, and September's allowable was raised 10,000 bbl. daily over August. Current actual production in the state averages 250,000 bbl. daily.

WEEKLY WELL COMPLETIONS . . . WEEK ENDED OCTOBER 1, 1949

	Total of all wells					Sep. 30		Wildcat completions and discoveries					Cumulative total, 1949				
	Comp.	Oil	Gas	Dry	Footage	1949	1948	Oil	Dist.	Gas	Dry	Total	Oil	Dist.	Gas	Dry	Total
New York	21	11	0	†10	25,851	586	1,039	0	0	0	0	0	0	0	0	0	0
Pennsylvania	35	12	8	†15	59,813	1,488	2,336	0	0	0	0	0	0	0	4	1	5
West Virginia	10	4	3	3	32,895	367	637	0	0	0	1	1	1	0	11	9	21
Ohio	27	11	5	†11	53,951	791	1,009	0	0	0	0	0	1	0	2	25	28
Indiana	18	8	1	9	32,571	947	776	0	0	0	2	2	26	0	2	176	204
Kentucky	20	7	7	6	40,538	712	669	0	0	0	2	2	23	0	0	59	82
Illinois	58	27	0	31	115,795	1,969	1,741	1	0	0	15	16	51	0	1	332	384
Michigan	30	12	1	17	71,565	743	612	0	0	0	10	10	21	0	3	230	254
Kansas	65	30	7	28	204,152	2,390	2,355	2	0	0	8	10	57	0	7	309	373
Neb., Mo., Iowa	3	0	0	3	10,059	19	54	0	0	0	3	3	1	0	0	14	15
Oklahoma	69	42	6	21	283,534	3,182	3,101	2	0	2	7	11	103	11	14	466	594
Texas	259	173	11	75	1,064,420	9,774	8,950	6	1	2	36	45	308	40	93	1,709	2,150
North Central (Dist. 7-B & 9)	81	42	3	36	223,454	3,267	2,686	2	0	1	12	15	*144	0	16	677	837
West (Dist. 7-C & 8)	81	73	0	8	393,525	2,356	2,427	2	1	0	3	6	*42	1	3	193	239
Panhandle (Dist. 10)	12	7	4	1	45,624	716	460	0	0	1	1	2	1	0	1	9	11
Eastern (Dist. 5, 6, & 6-P)	19	13	1	§5	83,347	559	428	0	0	0	3	3	8	4	3	113	128
Gulf Coast (Dist. 2 & 3)	24	18	2	4	127,370	1,446	1,411	2	0	0	3	5	62	28	39	292	421
Southwest (Dist. 1 & 4)	42	20	1	21	191,100	1,430	1,418	0	0	0	14	14	51	7	31	425	514
Louisiana	66	45	8	13	308,204	1,674	1,752	1	0	0	6	7	45	14	4	155	218
Northern	49	34	7	8	162,814	991	1,185	0	0	0	5	5	3	2	0	71	76
Southern	17	11	1	5	145,390	683	567	1	0	0	1	2	42	12	4	84	142
Arkansas	7	5	0	2	20,173	235	220	0	0	0	0	0	3	0	0	53	56
Mississippi	8	5	0	3	55,497	255	312	0	0	0	2	2	4	1	1	78	84
Southeastern States	1	0	0	1	1,699	36	38	0	0	0	1	1	1	0	0	31	32
Montana	2	1	0	1	5,071	220	239	0	0	0	0	0	3	0	2	24	29
Wyoming	11	4	1	6	50,002	441	385	0	0	0	1	1	21	0	0	86	107
Colorado-Utah	3	0	1	2	18,812	106	171	0	0	0	2	2	2	0	0	48	50
New Mexico	6	2	1	3	28,987	371	456	0	0	0	3	3	11	1	2	39	53
California	50	36	0	14	198,702	1,979	2,155	1	0	0	12	13	31	0	6	346	383
Total United States	769	435	60	274	2,682,291	28,283	29,007	13	1	4	111	129	713	67	152	4,190	5,122
Total previous week	789	449	62	278	2,924,000			19	2	6	111	138	700	66	148	4,079	4,993
Total October 2, 1948	818	473	75	270	2,901,903			16	2	2	89	109	661	56	194	3,691	4,602

Service wells included: †10, ‡14, §1, §2. *Revised.





DAILY AVERAGE PRODUCTION FOR WEEK

	Oct. 1 crude oil	B. of M. Sept. demand	Sept. 24 crude oil
Alabama	2,100	1,350	1,300
Arkansas	70,800	88,000	70,500
California	891,800	920,000	894,000
Colorado	64,500	70,000	65,600
Eastern	61,900	60,800	61,400
Florida	980	1,400	975
Illinois	179,900	180,000	176,100
Indiana	28,200	28,000	27,300
Kansas	262,650	302,000	275,250
Kentucky	23,400	22,000	23,500
Louisiana	491,900	528,000	486,400
North Louisiana	114,300		114,400
South Louisiana	377,600		372,000
Michigan	44,900	46,000	46,400
Mississippi	98,950	110,000	101,100
Montana	27,000	25,000	27,300
Nebraska	550	700	550
New Mexico	124,200	134,000	124,200
Oklahoma	401,000	410,000	391,000
Texas	1,988,400	2,130,000	1,979,100
Dist. 1 (Southwest)	27,200		27,200
Dist. 2 (Southwest)	123,050		122,700
Dist. 4 (Southwest)	189,950		189,300
Dist. 3 (Gulf Coast)	373,880		373,000
Dist. 5 (Eastern)	34,600		34,500
Dist. 6 (Eastern)	83,680		83,250
East Texas field	245,450		244,400
Dist. 7-C (West)	50,500		50,300
Dist. 8 (West)	565,880		560,300
Dist. 7-B (W. Central)	61,570		61,325
Dist. 9 (N. Central)	140,150		140,300
Dist. 10 (Panhandle)	92,470		92,525
Utah	2,200	900	2,050
Wyoming	127,500	122,000	127,100
Total United States	*4,892,830	5,180,000	4,881,125
Change from previous week, up	11,705		
Canada	72,500		70,920

Total production January 1-October 1 †1,387,283,020 bbl.
Same period last year (crude plus cond.) 1,506,778,190 bbl.

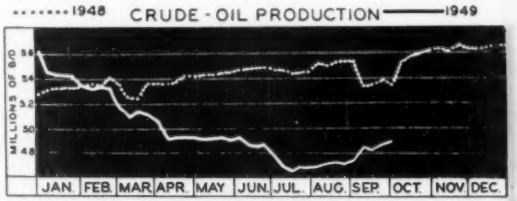
*Not incl. 79,480 bbl. condensate. †Incl. 22,675,860 bbl. condensate.

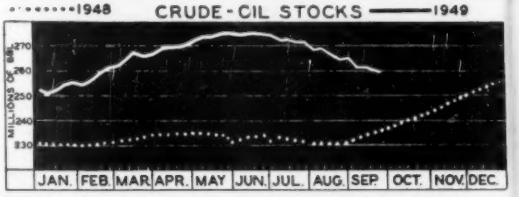
CRUDE-OIL STOCKS BY STATES OF ORIGIN*

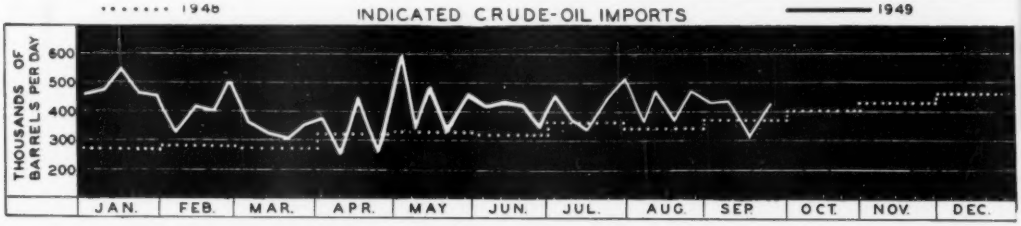
(Thousands of barrels)

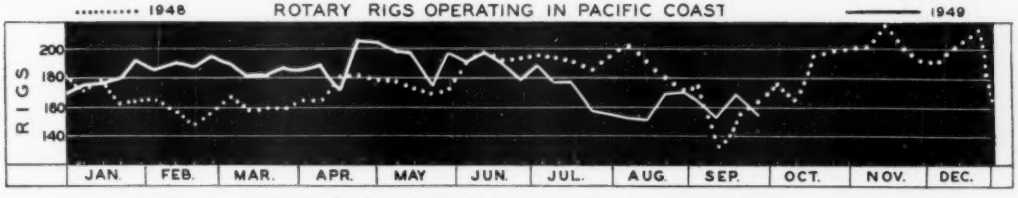
	Sept. 24, 1949	Sept. 17, 1949	Sept. 25, 1948
Pennsylvania Grade	3,210	3,261	2,791
Other Appalachian	2,114	1,936	1,326
Illinois, Indiana, Michigan	12,595	12,612	10,835
Arkansas	2,849	2,646	3,198
Louisiana	14,473	14,433	12,032
North	3,579	3,511	2,658
Gulf	10,894	10,922	9,374
Mississippi	2,680	2,761	2,689
New Mexico	7,328	7,477	5,709
Oklahoma and Kansas	38,416	38,625	34,974
Texas	118,835	119,965	113,058
East Texas	17,444	17,673	17,257
West Texas	46,738	47,455	42,741
Texas Gulf	29,329	28,461	28,986
Other Texas	25,324	26,376	24,074
Rocky Mountain	13,896	13,886	9,473
California	35,832	35,989	32,969
Foreign	6,961	6,818	5,139
Total United States	259,189	260,409	234,193

*Bureau of Mines.









Refining Statistics

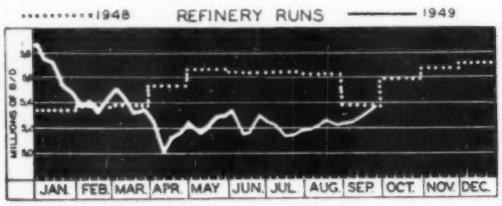
A.P.I. REFINERY REPORT, SEPTEMBER 24

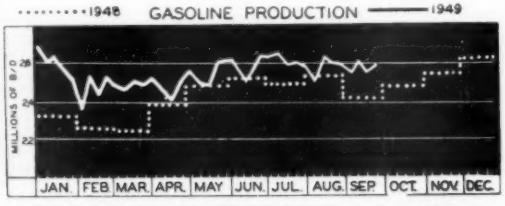
(Thousands of barrels)

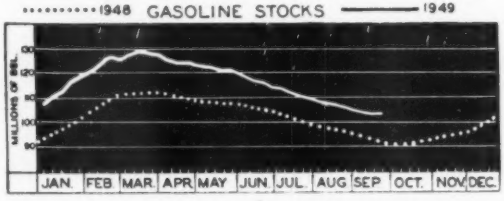
District	Daily avg. crude runs	Daily average production				Stocks at refineries, bulk terminals, in transit and in pipe lines			
		Gasoline*	Kerosine	Distillate	Residual	Gasoline	Kerosine	Distillate	Residual
East Coast	762	313.7	31.4	152.2	166.9	23,244	11,116	25,610	9,271
Appalachian:									
District 1	97	47.7	6.9	12.1	9.6	2,430	413	770	408
District 2	67	35.1	2.6	9.3	16.7	1,068	140	225	70
Ind., Ill., Ky.	932	493.3	47.0	130.3	139.6	22,260	3,342	12,914	3,881
Okla., Kans., Mo.	419	236.4	16.9	80.4	66.1	9,020	1,683	6,274	1,955
Inland Texas	198	141.3	12.7	17.7	41.1	3,672	801	963	1,451
Texas Gulf Coast	1,298	607.9	71.7	239.6	227.9	14,307	3,460	12,975	7,675
La. Gulf Coast	470	223.0	57.4	101.4	53.0	5,506	2,144	4,261	2,251
N. La. and Ark.	77	31.9	6.7	11.1	16.1	2,619	422	790	347
Rocky Mountain:									
New Mexico	11	5.4		1.4	2.6	60	35	96	32
Other Rocky Mtn.	187	84.3	7.4	35.6	33.7	2,438	382	2,075	597
California	859	373.1	12.1	145.3	286.6	16,638	677	14,461	40,205
Sept. 24, 1949	5,377	2,593.1	272.8	936.4	1,059.9	103,262	26,615	81,414	68,143
Sept. 17, 1949	5,306	2,549.3	251.3	952.4	1,069.3	103,331	26,436	80,114	68,527
Sept. 25, 1948	5,285	2,386.4	315.6	936.6	1,125.1	90,410	25,719	71,428	57,745

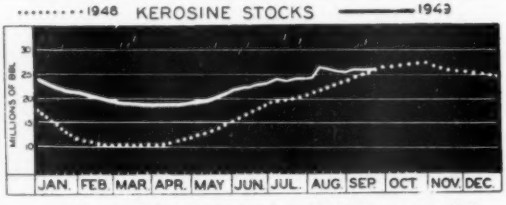
Bureau of Mines, September 1948				
Daily avg. crude runs	Daily average production			
	Gasoline*	Kerosine	Distillate	Residual
878	306.9	36.8	180.8	231.7
99	42.7	5.4	12.8	13.1
27	13.0	1.4	4.6	9.2
959	488.7	55.6	132.4	152.5
474	248.5	22.6	86.9	76.3
251	157.9	12.5	24.1	62.9
1,427	625.9	102.5	308.9	250.6
438	191.7	53.3	82.7	72.5
86	33.4	8.0	13.0	18.4
13	6.8	0.5	1.8	3.9
160	70.4	4.3	25.8	31.7
581	230.2	6.7	103.0	239.8
5,393	2,416.1	309.6	976.8	1,162.6

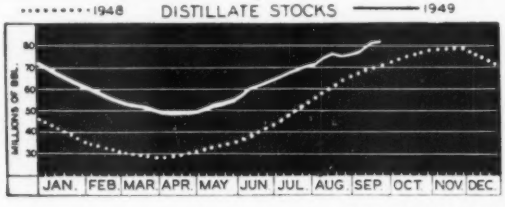
*At refineries including natural blended. †Finished and unfinished

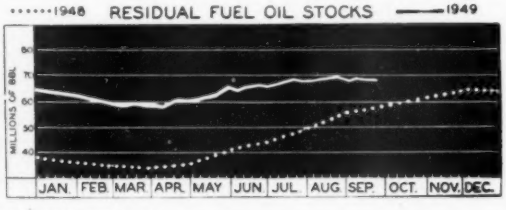




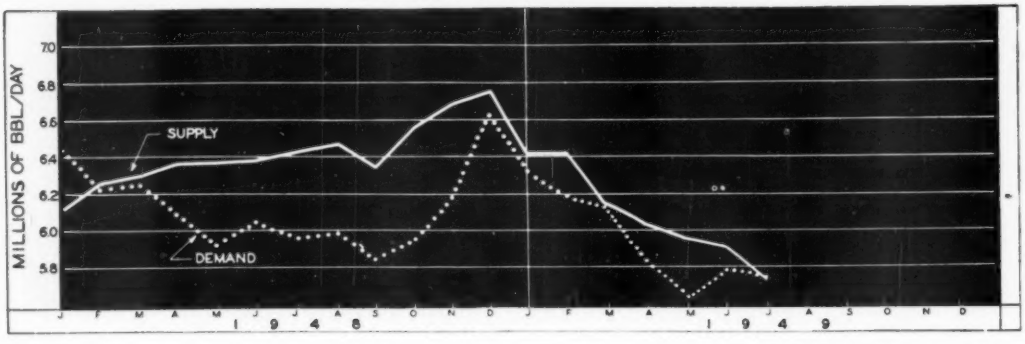








PETROLEUM SUPPLY AND DEMAND



CRUDE PRICES GRAVITY SCHEDULE

Gravity—	Signal Hill, Calif.	Oklahoma, Kansas	Gulf Coast Tex.*	West Tex.†
18-18.9	$1.53	....	....	....
19-19.9	1.63	....	....	....
20-20.9	1.73	$2.25	....	$2.12
21-21.9	1.82	2.27	....	2.14
22-22.9	1.92	2.29	....	2.16
23-23.9	2.02	2.31	....	2.18
24-24.9	2.12	2.33	$2.56	2.20
25-25.9	2.22	2.35	2.58	2.22
26-26.9	2.31	2.37	2.60	2.24
27-27.9	2.37	2.39	2.62	2.26
28-28.9	2.42	2.41	2.64	2.28
29-29.9	2.48	2.43	2.66	2.30
30-30.9	2.54	2.45	2.68	2.32
31-31.9	2.59	2.47	2.70	2.34
32-32.9	2.64	2.49	2.72	2.36
33-33.9		2.51	2.74	2.38
34-34.9		2.53	2.76	2.40
35-35.9		2.55	2.78	2.42
36-36.9		2.57	2.80	2.44
37-37.9		2.59	2.82	2.46
38-38.9		2.61	2.84	2.48
39-39.9		2.63	2.86	2.50
40 and above		2.65	2.88	2.52

*For crude from Daboval, El Campo, and Sand Point.

†Includes Lea County, New Mexico. Last general price change represented a 50-cent increase becoming effective December 6, 1947. Above changes do not include recent reductions of a few buyers applying principally to low-gravity grades

FLAT CRUDE PRICES

Representative posted schedules per barrel	
East Texas†	$2.65
Kettleman Hills, California*	2.77
Beauregard Parish	2.60
Illinois Basin	2.77
Pecos County, Texas (Yates)	2.35
Bradford, Pennsylvania	3.40
Eastern Ill. and Western Ind.†	2.77
Tomball, Texas Gulf Coast	2.83

*37°-37.9°, †35° and above

STRENGTHENING fuel-oil prices in most marketing areas of the country reflect the increased demand for these products after slack summer period that lasted until the middle of August.

Refinery demand for the four major products, calculated from refinery production and stock change, increased about 300,000 bbl. daily from June to September. Distillate fuels increased about 230,000 bbl. daily from the 5-week period ended July 2 to the 5-week period ended September 24. Kerosine was up 74,000 bbl. daily in the same period.

Most suppliers expect the October increase in distillate sales to be well above the normal seasonal gain. Last year, domestic demand for distillate was about 150,000 bbl. per day greater in October than in September even after a heavy consumer stocking program during the summer.

Gains in Mid-Continent distillate prices ranged from .125 cent to .25 cent per gallon on home heating fuels with even greater increases for ordinary gas oil. The heavy-fuel market was marked by the absence of distress material at low prices. Many Mid-Continent refiners have reduced residual inventories to good working levels.

Group 3 natural-gasoline quotations gained .125 cent per gallon for grade 26-70 with operators reporting the market very firm at the new level. At the end of the week, some material was moving at the old price in the North Texas area, but suppliers said that movement was strong at the increased price.

Decreases in crude and product stocks during September have been bases for increased crude-production allowables for October.

REPRESENTATIVE QUOTATIONS

Representative spot-market quotations of leading suppliers as of October 3, 1949. Figures are f.o.b. plant for tank-car shipments in cents per gallon, except for residual fuel oil which shows the price per barrel and wax, in cents per pound

GASOLINE, KEROSINE, AND FUEL OILS

	Mid-Continent Group 3	New York Harbor (barge)	Tex. Gulf Coast
Regular gasoline, 74-76 octane	9⅝-10	11.125-11.5	9½-10
Premium gasoline, 78-80 octane	10⅜-11	12.5	10½-11
42-44 w.w. kerosine	7¾-8¼	8.9	7¾-8¼
No. 2 straw fuel oil	6¾-7	8.5	7-7¼
No. 6 residual	$0.95-1.00	$1.90	$1.50-1.65

NATURAL GASOLINE

	Group 3	North Texas	N. La.
Grade 26-70	5⅞	5¼-5⅜	5⅝
Grade 18-55	7.1	6.3-6.5	6.8

LUBRICATING OILS
SOUTH TEXAS

200 vis., No. 2-3 neutral	10.5
750 vis., No. 3-4 neutral	12.75
2,000 No. 5-6 neutral	14-14.5

LUBRICATING OILS
Mid-Continent

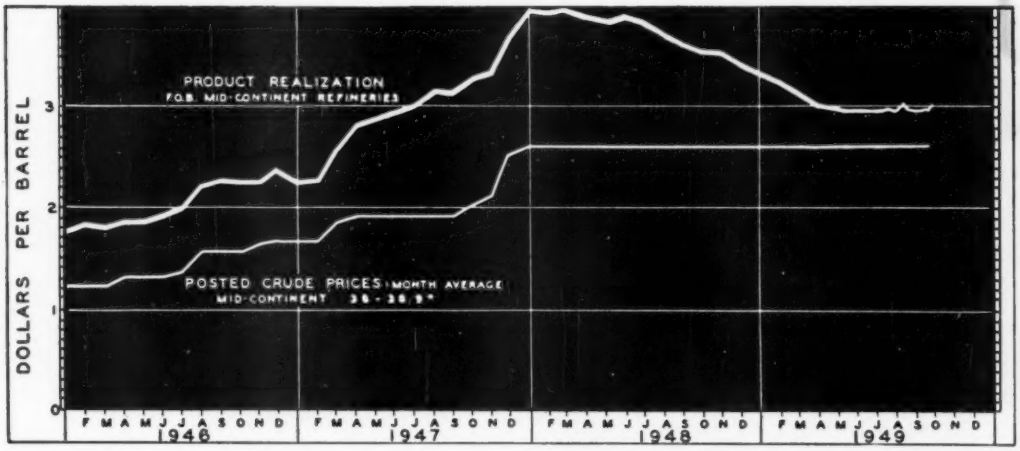
150-160 vis., D bright stock, 0-10 pp.	17-19
200 vis., No. 3 neutral, 0-10 pp.	12-14

Western Pennsylvania

145-155 vis., 10 p.t. bright stock	19.5
180 vis., 0 p.t. neutral	20.5

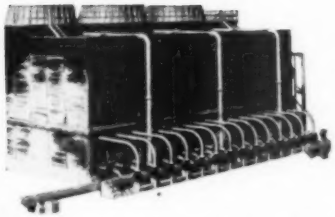
WAX
Mid-Continent

132-134 A.M.P.	4.25

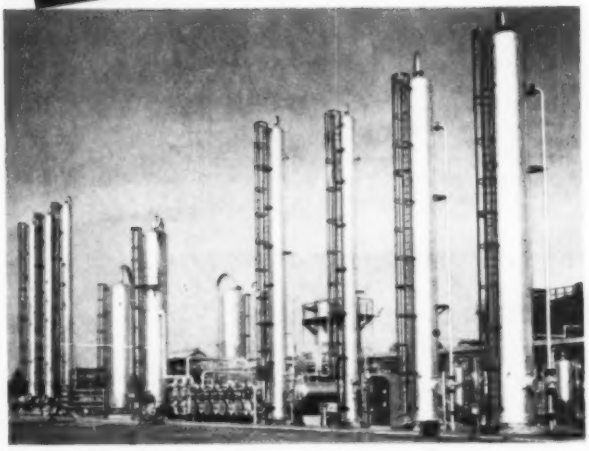


In this trend chart refinery realization is based on average Mid-Continent grade crude oil (not 38° gravity only) and average prices for refinery products as published in The Oil and Gas Journal basis Oklahoma (Group 3). Refinery yields confined to gasoline, kerosine, distillate, and fuel oil

CONTROL
Scale and Corrosion



in Cooling Towers, Compressors, Engine Jackets



Wherever WATER is used in the Petroleum Industry there is need for WRIGHT CHEMICALS to protect equipment from scale and corrosion. Wright Chemicals are specifically formulated for individual applications.

There is a Wright Field Engineer near you to help with your water-conditioning problems.

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WRIGHT CHEMICAL CORPORATION

Specializing in Water Conditioning

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OFFICES IN PRINCIPAL CITIES
SOLE DISTRIBUTOR OF NELSON CHEMICAL PROPORTIONING PUMPS

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Use a Powers Regulator

Maintains constant temperature. Controls flow of gas, steam, water or oil. Sizes ¼ to 6". Available with single, double seat, and 3-Way Valve. Corrosion resistant and ruggedly built to give the dependable service required by the oil and gas industry. Write for prices. (P2)

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Chicago 14, Illinois
Offices in 50 Cities • Established 1891

SIMPLE • DEPENDABLE • ECONOMICAL

▶ *Write for Bulletin 329P*

POWERS No. 11 Self-Operating REGULATOR

Special Train to the A.P.I. Convention in Chicago

A. P. I. CONVENTION

LEAVING TULSA FRISCO 5:15 PM Nov. 6
ARRIVING CHICAGO GM&O 8:00 AM Nov. 7

Pullman equipment consists of bedroom, roomettes, drawing-rooms, compartments, and berths . . . Lounge and dining service.

For those planning to attend advance committee meetings, we suggest through sleeping car service on the streamlined Meteor which leaves Tulsa 9:45 pm and arrives in Chicago 2:08 pm.

For Frisco reservations and information concerning hotel facilities in Chicago . . .

PHONE FRISCO — 3-3151
Kennedy Building, Tulsa, Okla.

FRISCO GM&O

Special train, returning, will leave Chicago 4:40 pm. November 10th; arrive Tulsa 8:00 am November 11th.

EQUIPMENT MEN . . . in the News

Howard Heads New General Paint Branch

G. S. HOWARD

PAUL NORMAN

George S. Howard, veteran of General Paint Corp.'s sales and service staff in the oil and general industrial field for 26 years, is being transferred to Houston, according to E. R. (Bill) Cluff, general manager of the company at Tulsa.

Howard will be in charge of the new warehouse branch, which will be in operation by the first of the year to serve the Gulf Coast oil industry and industrial trade. Three salesmen will cover the territory under Howard's supervision. Howard will be succeeded by Paul Norman, member of General Paint's Tulsa organization.

Sigmund Standardizes Pump Parts for Shell Plant

Sigmund Pumps, Gateshead, England, which furnished a large number of the pumps installed at the new refinery constructed by Shell Chemical Manufacturing Co., Ltd., located at Stanlow, near Ellesmere Port, on the Manchester ship canal, has prepared a statement on the manner of selection of pumps for each application in the plant.

The statement says in part: "All kinds of liquids, from propanes and butanes to viscous fuels had to be dealt with. These conditions demand extreme reliability of the pumps throughout, but especially of the shaft sealing member, in order to reduce leakage to an absolute minimum.

"The large number of pumps involved created a considerable maintenance problem. To deal with all these aspects, all the duties to be performed were grouped. Three basic pump designs were selected: a single-stage pump, a two-stage pump, and a multistage barrel pump. Within these groups steps were taken to keep variations of parts to a minimum by using the same internal parts in all three groups. About half of the total number of pumps supplied by Sigmund use the same wear rings, shaft sleeves, and other wearing parts. There are only two sizes of impellers used in these pumps, differing only in width."

Salvatori and Associates Buy MacClatchie Plant

H. SALVATORI

Henry Salvatori, president of Western Geophysical Co., and Grant Oil Tool Co., announced that he and his associates have assumed ownership of MacClatchie Manufacturing Co., Los Angeles. Addition of MacClatchie products will further round out the wide range of oil-field equipment and services now available through Grant Oil Tool Co., and Western Geophysical Co. All of the items manufactured by MacClatchie, including mud-pump pistons, piston rods and liners, wall scrapers, well-control equipment, catheads, derrick tools, and bottom-hole tools will continue to be manufactured under the MacClatchie name.

Butcher Elected Vice President of Elliott Co.

C. A. BUTCHER

Charles A. Butcher was elected a vice president of Elliott Co., effective last month. According to Grant B. Shipley, chairman of the board, Butcher will continue to function as general manager of Crocker - Wheeler Electric Manufacturing Co., Ampere, N. J., a recently acquired division of Elliott.

Butcher received his B.S. and E.E. degrees from Iowa State College. He has more than 30 years of experience in many phases of the electrical field, and has several patents to his credit, including an automatic switch for controlling circuit breakers.

Mid-Continent Opens Snyder Field Store

Mid-Continent Supply Co. has recently opened a new field store, located in the Scurry County area at Snyder, Tex., which will be completely stocked with the entire line handled by Mid-Continent. The store will offer 24-hour service to surrounding areas.

Including store manager, D. C. McIver, formerly at the company's Eunice, N. M., store, personnel at the Snyder store consists of R. E. Dunn, field salesman, formerly at Eunice; T. R. Fleeman, field salesman, formerly at Hobbs, N. M.; C. L. Washburn, formerly at Eunice; W. B. Nance from the Sundown store; E. M. Wilson and M. H. Ross from Odessa, Tex.; and W. W. Taylor, Jr., of Fort Worth.

Ferguson Made Guiberson Field Service Salesman

Effective immediately, L. T. (Tater) Ferguson will represent Guiberson Corp. as field service salesman in the states of Illinois, Indiana, and Kentucky. Ferguson has been with Guiberson for 7 years, having previously been located in Dallas and Odessa, Tex.

A. O. Smith To Build New Houston Welded Pipe Plant

A. O. Smith Corp., Milwaukee, has announced the formation of A. O. Smith Corp. of Texas, which will build and operate a plant at Houston for the manufacturing of welded steel pipe for gas and oil transmission lines, and for oil-well casing.

Line pipe manufactured at the plant will range in diameters from 8⅝ in. up to 30 in. and larger if required, and will be fabricated in uniform lengths of 40 ft. The plant will have a capacity of from 30,000 to 35,000 tons of pipe per month and will be the second largest mill in the country for the production of welded pipe.

The new plant will be located adjacent to the present Houston works of A. O. Smith and also adjacent to the plant of Sheffield Steel Corp. which will provide most of the steel. Sheffield Steel Corp. is a wholly owned subsidiary of Armco Steel Corp. of Middletown, Ohio.

This new operation has been set up as a separate company. The capital stock of the new company will be

held equally by A. O. Smith and Sheffield Steel.

The plant will be built at a cost of about $5,000,000 and it is estimated that it will create from 1,000 to 1,500 new jobs in the area, both to operate the mill and expanded operations required at Sheffield to supply steel. Construction of the plant will start at once and the expected completion time is summer of 1950.

Officers of A. O. Smith Corp. of Texas are: A. Von Wenning, chairman of the board; L. B. Smith, president; John M. Floyd, vice president; D. F. McCarthy, vice president and general manager; and M. J. Vollmer, secretary and treasurer. All are officials of A. O. Smith Corp. of Milwaukee.

Directors will include R. L. Gray, president of Sheffield; J. C. Shepherd, executive vice president of Sheffield; L. H. Juengling, Sheffield secretary; F. R. McFarland, Sheffield division manager; Smith; Von Wenning; Rae F. Bell, A. O. Smith board chairman; and W. C. Heath, president of A. O. Smith of Milwaukee.

Jackson Forms Middle West Corrosion Mitigation Firm

Maynard H. Jackson announces the opening of Middle West Coating & Supply, Tulsa, offering a complete line of corrosion - mitigation products. The firm will handle only products that are used in protection of pipe and other metallic surfaces, such as coal-tar enamels, Koppers cold coatings, Oklahoma Glass Fiber reinforcement, pipe-line felts, cathodic protection equipment with rectifiers, anodes, insulating flanges, and fasteners.

Jackson has had 9 years' experience in steel-mill engineering and 10 years with Johns-Manville, including 3 years as district engineer and the remainder as oil and steel representative. He was with Hill, Hubbell as Middle West representative and recently was sales manager of Standard Pipe-protection.

Big Four Opens Export Office in New York

Big Four Machine & Supply Co., manufacturers of oil-field equipment, Clay City, Ill., has recently opened an office in New York City to better serve the export trade, according to John R. Riley, president of the company. Jack Askins will be the Big Four representative at the office, located in the Woolworth Building.

Big Four is now operating a newly acquired plant at Pawhuska, Okla. The plant was formerly owned and operated by Murray Tool & Supply Co.

Mars Named Manager of Ansul Products Department

C. V. MARS

R. J. YAEGER

C. Victor Mars, formerly sales manager of Ansul Chemical Co.'s industrial chemical division, has been named manager of the company's new-product department. Robert J. Yaeger succeeds Mars as industrial chemical sales manager.

In his new position Mars will coordinate all new product and development work. Ansul is interested in continuing to find new industrial uses for its two chemicals, sulfur dioxide and methyl chloride, as well as new products based on these chemicals.

Nomads See Films on Naval Petroleum Reserve No. 4

Two reels of the U. S. Navy film covering the Navy's Petroleum Reserve No. 4, were shown before the last meeting of the Los Angeles chapter of Nomads held on September 14.

Five new requests for membership were offered at the meeting for Onos Lindsay, Eastman Oil Well Survey Co.; Frederick B. Williams, Baroid Sales division; D. J. Bergeron, Baash-Ross Tool Co.; Daniel M. Bernt, Pacific Perforating Co.; and Art Moore, Oil Base, Inc.

Foreign guests at the meeting were: Ralph H. Connor, returning to the United States after serving several contracts with Basrah Petroleum Co., Tripoli, Lebanon; Zell W. McCoy, Texas Petroleum Co., Bogota, Colombia; C. B. Ridgeway, Arabian American Oil Co., Saudi Arabia; T. A. Connor, Iraq Petroleum Co., Iraq, home on sick leave after an oil-field accident; Algar L. Ridgeway, Standard Oil Co.; W. K. Kirby, Canso Azul, Lima, Peru; William Ohlandt, Jr., Texas Petroleum Co., Caracas, Venezuela; J. G. Woods, Richmond Exploration Co., Maracaibo, Venezuela; John L. Everett, Mene Grande Oil Co., Venezuela; G. H. Atkins, Creole Petroleum Corp., Venezuela; C. H. Strickland, Iraq Petroleum, Iraq; C. M. Williams, Iraq Petroleum, Iraq; C. R. Devine, Basrah Petroleum, Iraq; and Wladimir Ziloff, Pantapec Oil Co., Venezuela.

Some of the foreign guests who attended the September meeting of Los Angeles Nomads were: (Seated) William Ohlandt, Jr., C. B. Ridgeway, G. H. Atkins, C. H. Strickland, and C. R. Devine. (Standing) T. A. Connor, Wladimir Ziloff, Ralph H. Connor, and C. M. Williams

Maloney-Crawford Names Rocky Mountain Salesman

W. H. CONNOR

W. H. Connor, of W. H. Connor, Inc., Casper, Wyo., has been appointed representative in the Rocky Mountain area for Maloney-Crawford Tank & Manufacturing Co., of Tulsa, according to S. P. Wallace, Maloney-Crawford president. Connor has been associated with the steel-tank and separator business for many years.

Scherffius Named to New Position With Koppers Co.

Supervising engineer William S. Scherffius has been named personnel manager of the engineering and construction division of Koppers Co., Inc., Joseph Becker, vice president and division general manager has announced.

As personnel manager, Scherffius will develop, direct, and coordinate personnel and labor-relations policies and functions on the many construction projects of the engineering and construction division.

Scherffius joined Koppers as a cadet engineer in the engineering and construction division on construction work in Montreal, Can., in 1927.

Chain Belt Opens New Dallas Warehouse

Chain Belt Co. of Milwaukee has recently opened this new warehouse in Dallas to serve the Dallas district sales office. A complete line of Rex and Baldwin-Rex chain for oil-field use along with transmission parts, shafts, sprockets, speed reducers, bearings, and pulleys will be maintained at the new location

Controllers Institute Announces New Officers

R. W. LEASON

H. J. MAMMOSER

R. W. RAGER

Roger W. Leason, vice president and treasurer of Emsco Derrick & Equipment Co., has been elected president of the Los Angeles Control of the Controllers Institute of America. Harold J. Mammoser, treasurer and controller of Tokheim Oil Tank & Pump Co., has been chosen for the same position by the members of the organization's Fort Wayne Control.

New president of the Institute's Dallas Control is Ralph W. Rager, vice president of Oil Well Supply Co., Dallas. William S. Hendry, secretary of Gilbert & Barker Manufacturing Co., West Springfield, Mass., has been named vice president of the Springfield branch of the institute.

Dee Davis, secretary and treasurer of The California Co., New Orleans, and Wilson K. Minor, assistant controller of Standard Oil Co. of California, San Francisco, have been elected vice presidents of the local controllers' group in their respective cities.

Other executives from the industry who have been elected directors of local controls include: Russell G. Bannister, Petrol Corp., and Donald F. Jones, Sun Oil Co., both of Philadelphia; George L. Duwe, Cameron Iron Works, Weldon M. Padgett, Schlumberger Well Surveying Corp., and Fladger F. Tannery, Humble Oil & Refining Co., all of Houston; George G. Hefner, Atlantic Refining Co., Dallas; Lewis E. Frensley, Magnolia Pipe Line Co., Dallas; Howard Jurgens, Sherwood Brothers, Inc., Baltimore; E. Chester Peet, vice president and treasurer, Shell Oil Co., and Leith V. Watkins, Panhandle Eastern Pipe Line Co., both of New York; and Frank S. Slick, Ohio Oil Co., Findlay, Ohio.

Pharr, Rogers Get New Braden Positions

William D. Moorer, president of Braden Steel Corp., Tulsa, has announced the appointment of J. C. Pharr of Tulsa as vice president in charge of operations. The company has also announced the election of R. W. Rogers of Houston to the board of directors.

Bethlehem Supply Makes Changes in Sales Staff

Bethlehem Supply Co. has announced several personnel changes in its field sales organization.

W. L. Coleman, former field representative at the Seminole, Okla., store, has been transferred to Ardmore, Okla., and will operate as a field salesman in that increasingly active area. A. M. Taylor, formerly at Oklahoma City, has been transferred to Seminole and promoted to the position of field representative. Taylor will assume the former duties of Coleman.

C. W. Young, a special representative, has been transferred to Garden City, Kans. He will direct his efforts to field sales in the Garden City area. F. M. Matzke has recently joined Bethlehem in the capacity of field representative and will work out of the Casper, Wyo., store.

Oilwell Announces Changes In Sales Organization

Southwest district of Oil Well Supply Co. has announced a number of changes in its sales organization. Under Mark Barkhurst, Mid-Continent division manager, the company has opened a new branch sales store at Elk City, Okla., to serve western Oklahoma. Manager of the Elk City store is James M. Reid, formerly field representative at Cushing, Okla.

Appointment of B. A. August as sales manager for Oilwell's Gulf Coast division, with A. D. Butler to succeed him as manager of the Southwest Texas district was announced by F. D. Smith, division manager at Houston. John W. Nabb, manager of the Mirando City, Tex., store has been named to succeed Butler as manager of the Alice, Tex., store.

T. E. Bowers, assistant manager of Oilwell's West Texas district, has been promoted to district manager under V. J. Waters, Central Midwest division manager.

Barkhurst also announced the appointments of field representatives and two branch-store managers in the Kansas district. A. C. McDonold, formerly manager of the Ellinwood, Kans., store has been named field representative at that city. He is succeeded by E. W. Alexander, formerly manager of the Russell, Kans., store. Lewis Y. Poland, storeman in the Russell store, succeeds Alexander.

S. W. Osborne has been named to the Mid-Continent division sales staff at division headquarters in Tulsa and D. O. Smith will succeed Osborne as Oklahoma district manager. Charles E. Craft has been appointed district material supervisor of the South Louisiana-Mississippi district of Oilwell and he will be succeeded as field representative at Victoria, Tex., by Edward T. Fowler, formerly storeman at Victoria.

Classified Advertising

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All ads, 12 cents a word. Minimum charge, $3.00 per insertion.
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$12.00 per column inch per insertion. One-point border and 12-point capitals are allowed. Larger type sizes not accepted.

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FOR SALE: Failing Model 1500 Heavy Duty Rotary drilling rig, equipped with 4½" x 6" mud pump, mounted on 1948 International KB6 truck, complete with drill pipe, subs, tools, etc. Also 800 gallon custom built water tank, equipped with vacuum lift, mounted on 1948 International KB6 truck. All equipment in excellent condition. Address: Box D-168, The Oil and Gas Journal, Tulsa, Okla.

FOR SALE: Cardwell Rotary Rig, complete with Mast. Suitable for 3,500 ft. drilling. Bargain. Terms. Melton Supply Co., Seminole, Okla.

FOR SALE: Two like new 74,000 bbl. cap tanks. Low price, at Morgantown, W. Va. 2 new 10,000 bbl. bolted at N.Y. Darien Corp., 60 E. 42nd St., N. Y., N. Y.

Several Army Surplus 4½" x 6" Gaso Duplex 1860 Pumps—two piece skid mounted with Chrysler 8 cylinder engines. Will sell pumps only or complete units about half price.

H. H. COFFIELD
ATTN: W. H. Orr
Phones: 132—Rockdale, Texas
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DIESEL ENGINE FOR PIPE LINE

225 HP Busch Sulzer Model 3DF17, 360 RPM. 175 HP at 300 RPM. 3 cyl., 4 cycle, solid injection. Complete, late model. Excellent shape. $3200 f.o.b. St. Louis.

MISSISSIPPI VALLEY EQUIPMENT CO.
511 Locust St., St. Louis 1, Mo.

EQUIPMENT FOR SALE

FOR CABLE TOOLS
DEGEN PIPE AND SUPPLY CO.
Box 107, Red Fork Station, Tulsa, Oklahoma

CARDWELL RL SPUDDER. Completely equipped. Good operating condition. Located Central Oklahoma. For prices and terms write: Barnes Drilling Company, 22 West Fourth St., Tulsa, Oklahoma.

ROLAGRIP COUPLINGS—For Sale, 100 tons, 1½" to 8" line, Blk. & Galv. Complete with bolts and neoprene gaskets. Never in use. Send for list and price. Julius M. Fogelman, 1649 Perkiomen Ave., Reading, Penna.

FOR SALE

In excellent mechanical condition located in West Texas:

1, IDECO Model PR-150 Drawworks complete with air flex clutches and 145-GKU Waukesha Gas-Gasoline-Butane engine with Brown Lipe transmission.
1, 5 x 10 Gardner-Denver power pump unitized on steel skids with Model L-525 Buda Gas-Gasoline-Butane engine.
1, 87' Lee C. Moore Jack Knife Derrick complete with sub base and with 5' substructure, walks and stairs.
1, Brewster Model OB 12" Rotary Table with master bushings.
1, BJ Model 75 hook.
1, 1½ KW Kohler Light Plant.

Equipment must be seen to be appreciated.

Write, wire or phone

EMPIRE MACHINERY COMPANY, LTD.
Box 4026, Phone LD 18 or 9161, Odessa, Texas

NEW FRACTIONATING TOWER REFLUX DRUM

One (1) New fractionating tower, 5'-0" I.D. X 89'-6" over-all height X 1¼" plate. Thirty-four (34) bubble trays, ten (10) 18"-300# manways. Stress relieved and built in accordance with API-ASME Code for 350 PSI working pressure.

One (1) new horizontal reflux drum, 5'-6" I.D. x 18'-6" over-all length x 1 ⅛" plate. Stress relieved and built in accordance with API-ASME Code for 350 PSI working pressure.

ROCK ISLAND OIL & REFINING CO., INC.
335 West Lewis St. Wichita, Kansas
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EQUIPMENT FOR SALE

CORE Drilling & Shot Hole Rigs: Longyear, Sullivan, Franks. New and used equipment, ready for service. PK rods, N rods, B rods, bits, Spudders and cable tools. Everything for well drilling. We save you money. Pressey & Son, Pueblo, Colo.

FOR SALE: Reboiler, Jackson Engineering, size 16-35-75, tube pressure 175 lbs., temperature 380° F. Model #1, Heater #265. Excellent condition. Box 610, Mt. Pleasant, Texas.

FOR SALE: Our complete stock. Around 50 pumps of various sizes and kinds—geared, centrifugal, and steam. Attractive discounts either single or in lots. All pumps in good shape. Gladewater Pipe and Supply Co., Box 391, Gladewater, Texas.

FOR SALE: Complete Oil Field Electric Generating Plant now furnishing electricity to pump thirty-four producing wells. Contact A. B. Allen, Flora, Illinois.

NEW 6⅝" O.D. API LINE PIPE

73 miles new 6⅝" O.D. 13# API Electric Weld Line Pipe.

ROCK ISLAND OIL & REFINING CO., INC.
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PACKAGED H_2S REMOVAL UNITS

We offer prompt shipment on skid-mounted hydrogen sulfide removal units for treating sour gas for pipe line or fuel gas purposes.

GRAFF ENGINEERING & EQ'PT. CO
3415 Westminster, Dallas 5, Texas

FOR SALE

12—230 H.P. Type 10 Bessemer New 17" Power Cylinders complete ready to run with 16" to 18" Compressors. 1—230 H.P. Clark Horizontal with Compressors. Located Salem, Illinois.

ENGLE PETROLEUM, Incorporated
Box 655, Evansville, Indiana

PIPE THREADER

1—#8 HD Jarecki, High Speed, Pipe Threader, capacity 1½" to 8", complete with chasers and six sets new dies, Timken fitted, 6 spindle speeds, automatic, self-opening die head—cut off and reamer attached, complete with 5 HP motor, mounted in base. BARGAIN PRICED.

STEWART BOLLING & CO., INC.
3190 E. 65th St.
CLEVELAND 4, OHIO

COMBINED VAPOR SEPARATOR & FRACTIONATOR FOR THERMAL REFORMING

One (1) New 5'-6" ID x 61'-0" over-all height Bubble Tower made of 1¼" Plate and lined throughout with 5/64" and 7/64" thick, 11-13% Chrome stainless steel, type 405. Stainless steel support plates in place for 15 Trays, (Trays not included). Constructed in accordance with the API-ASME Code, stress relieved and radiographed. Designed for 400 PSI @ 750° F. Fabricated by A. O. Smith Corporation. Platform and ladder clips installed.

WOOD RIVER OIL & REFINING CO., INC.
335 West Lewis Street, Wichita, Kansas
Telephone 7-3325

FOR SALE

12),000'—6⅝" OD, 17.65#, seamless, range 3, beveled.
80,000'—4½" OD, 8.65#, seamless, range 3, beveled.
Ready for immediate delivery, A-1 every respect, priced to sell. Location, Tulsa, Oklahoma.

W. C. BERRY
Box 1858 Tulsa, Oklahoma Phone: 3-6141

MODEL 6-LRO WAUKESHA ENGINE

Operated total of 250 hours

8½" bore x 8½" stroke, 2894 cu. in. displ. Complete with radiator, clutch power take-off, starting engine, LPG heat exchanger and all standard accessories. Substantial discount.

LUCEY PRODUCTS CORPORATION
624 S. Cheyenne TULSA, OKLAHOMA Phone: LD 204

EQUIPMENT FOR SALE

FOR SALE, at Oklahoma City: 17,500′ of 2⅞″ OD 6.4 upset seamless steel tubing line pipe and 12,500′ of 3″, 7.7 TMC and PE line pipe, all used. Cheap. Cities Service Oil, Patridge, Bartlesville, Okla.

FOR SALE: Two Fairbanks-Morse Diesel Engines, 150 H.P. Twin Cylinder, Horizontal Type. Completely overhauled. $1500.00 each. Melton Supply Co., Seminole, Okla.

FOR SALE: Truck-mounted 30 HP Bettis Steamer, complete with water tank, fuel tank, tools. Suitable for steam cleaning, oil treating. Dave Edmiston, Russell, Kansas.

BREWSTER DRILLING RIG 5000 ft. depth, Moore 87 ft. jack knife. Excellent condition. Address "Drilling Rig," Box 949, Henderson, Texas.

FOR SALE: Failing "1500" portable rig for shot-hole, core, water-well, and shallow production drilling. Equipped with sand reel and bailer. Mounted on GMC truck. Rig and Truck in excellent condition. Rider & Montgomery, Box 523, Douglas, Wyoming.

FOR SALE: In West Texas, Model 61 Wichita Spudder, complete with 150 H.P., LeRoi Drilling Engine, all tools, dog house, light plant, and Shear Pole Mast. Rig is mounted on 12″ I Beam Skids. Box D-228, The Oil and Gas Journal, Tulsa, Oklahoma.

FOR SALE: Mayhew Shot Hole Drilling Rig mounted on 1947 Ford truck. 550 gallon water tank mounted on 1947 Ford truck. Complete with all equipment, in good condition, ready to move on job. Priced to sell. F. W. Brown, Box 607 or Phone 400, Britton, Oklahoma.

FOR SALE: 1—Pipe pulling outfit complete with Caterpillar tractor, and Cardwell single drum winch, with spudder attachment, 48′ wood-A-Mast and all tools. Price $3500.00; 1—Extra Pipe pulling pole mounted on dual wheel rubber-48′-long-5-sheave Western Iron crown. Price $1000.00; 1—Converted Star spudder, #26 Caterpillar 30—Tractor powered—Tools, but no lines. Price $1750.00; L. B. Finney, Box 455, Madison, Kansas.

ONE Ironcraft and five Kelpsch type floating marsh buggies. For inspection and price bid contact James, Linden 5108, or mail inquiries to 1012 Claxton Street, Houston 17, Texas.

FOR SALE

One Wilson Giant Hydromatic rig complete with 129′ L. C. Moore derrick and 6000′ 4½ drill pipe. Rig capable of drilling 8000′. Completely equipped, in excellent condition and ready to drill.

One Wilson Atlas Rig complete with 129′ L. C. Moore derrick and 6000′ drill pipe, 4½. Rig capable of drilling 9000′. Completely equipped, in excellent condition and ready to drill.

Priced for immediate delivery, subject to prior sale at $65,000.00 each.

JOE FOWLER

1009 City Nat'l Bldg. Phones 2-5401-2-3

Wichita Falls, Texas

DIESEL GENERATORS

60 KW G.M. 6-71RC, 3 60 127-220, complete. Only 100 hrs. operation.

100 KW Hercules DNX-6, 3 60 127-220. Unit completely enclosed.

100 KW Superior GDB-8, 120-240 DC, complete. New 1942-3.

AIR COMPRESSORS

NEW I.R. Centrifugal, 4 stage, single flow, 6500 CFM, 10#, motor driven.

Fuller, rotary, type C-300, single stage, 1600 CFM, 25#, motor driven.

HEAT & POWER CO., Inc.

70 Pine St. Digby 7-0373 New York 5

EQUIPMENT FOR SALE

404 CORE BARREL—Drills faster, takes larger core, runs in 6¼ inch casing. Makes 2⅞ inch core. Price & quoted on request. M'f'g by East Side Machine Works, 17 S. Ashby, Chanute, Kansas.

FOR SALE: One 25 KVA and one 24 KVA Electric Machinery Company generators complete with exciter, and direct-connected to 55 h.p. four-cylinder gas or gasoline driven Model U-9 International engine with each unit unitized and mounted on individual steel skids. Each Unit slightly used and priced at $2,000 each. One slightly used B.S. & B. 125 pound psi. separator complete with pilot control, pop valve and safety head, size 30-inch by 10-feet, capacity six million feet per day, price $425.00; one slightly used 200 pound p.s.i. Peerless type M-1 odorizer complete, price $300.00. Also several three and five h.p. explosion-proof electric motors, Nordstrom valves, regulators, welding saddles, flanges, and miscellaneous high and low pressure fittings. Call or wire E. F. Hindman, Louisiana Natural Gas Corporation, telephone 6-2509, Lake Charles, Louisiana.

FOR SALE: 15,000′ of 6⅝″ O.D. line pipe—40′ lengths—excellent condition. H. L. Smith, St. Elmo, Illinois. Phone 115.

New Wire Rope at Money-Saving Values: Leading brands. Sizes ⅛″ to 1⅛″, 6x19, 6x37, construction for all purposes. Degen Pipe & Supply Company, Box 107, Red Fork Station, Tulsa, Oklahoma.

FOR SALE: McKissick Tubing and Floor Blocks. Save 50%. Melton Supply Co., Seminole, Okla.

FOR SALE: Skid mounted double drum spudder, 7000 foot capacity, complete. Box D-223, The Oil and Gas Journal, Tulsa, Oklahoma.

FOR SALE: R L Spudder completely equipped. NEW 5000′—9 16″ sand line and NEW 5500′—⅞″ drilling line. Unit in exceptionally good working condition. Write Box 647, Great Bend, Kansas.

ORIGINAL Askania tre-compensated vertical magnetometer 10 gammas scale division. Perfect shape and conditions. $2,500.00. Box D-222, The Oil and Gas Journal, Tulsa, Oklahoma.

FOR SALE: D-13000 Caterpillar Diesel Engine, $2,500.00 F-23 O.C.S. Jackshaft Clutch $600.00; C. O. Jones, Box 510, ElDorado, Kansas.

FOR SALE at Bartlesville—1 ELI Shot Hole Drill Truck with 4″ x 5″ Gardner Denver Pump mounted on 1945 1½ ton Ford Truck, $2,000.00. Cities Service Oil Co., Patridge, Bartlesville, Okla.

FOR SALE: New Beaird Packaged Compressor Plant with Ingersoll-Rand Type 6XVG 225 HP two stage gas compressor equipped with hand operated fixed volume pockets. Intake pressure range 100-200 PSI. Discharge pressure 1000 PSI. Capacity range 1,450 to 2,050 MCF. Ready to operate. Location Bishop, Texas. Box D-161, The Oil and Gas Journal, Tulsa, Oklahoma.

FOR SALE: Approximately 25 miles 4″ OD plain end pipe in line. Public Service Corp. of Texas, 902 Burk Burnett Bldg., Fort Worth, Texas.

FOR SALE: Cardwell Model "RL" Spudder complete, Waukesha Motor, almost new lines, steel roof and floor, side curtains, new doghouse, two complete strings of tools, Koehler light plant, 1250 gal. Butane tank—now on location near Grayville, Illinois. Geo. H. Wickham, Box 595, Phone 149, Grayville, Illinois.

EQUIPMENT WANTED

WANTED: Fort Worth Jumbo "D" spudder. Preferably without tools or engine. Quote price, year, condition, and location. G. W. Hicks, Box 125, Moline, Kansas.

SERVICES

INSPECTION SERVICE

A group of experienced refinery inspectors are forming an independent inspection service to provide inspection service to refineries, gasoline plants, and to provide other inspection services required by customers. Proposed starting date of service to be January, 1950. Headquarters to be in Houston, Texas. If interested please write for details. Box D-217, The Oil and Gas Journal, Tulsa, Oklahoma.

HELP WANTED

NEW foreign and domestic Oil Employment Directory. Over 500 listings in drilling, production, refining, natural gasoline, pipe lines, geological, exploration, supplies, manufacturers, services; and trucking, refinery and pipe line contractors, showing where to apply for jobs. Price $5.00. Oil Industry Mailing List, Box 2603, Tulsa, Okla. (Our 28th year).

MUD ENGINEER or chemist to act as sales representative for new product, Kingseal, which is an oil well mud sealing fiber. Kingseal regains and prevents lost circulation. Laboratory and actual field tests prove Kingseal superior to any other product on the market. Prefer man with lengthy experience in Texas drilling and oil production. Kingseal is copyrighted and patent is applied for. Write owner, Homer L. Twining, Sta. A., Box 4151, San Antonio, Texas.

GEOLOGIST, with four or more years' active experience in North Louisiana and able to qualify as district geologist. Headquarters in Shreveport. Prefer man under 35. State salary desired. Replies held in confidence. Box D-231, The Oil and Gas Journal, Tulsa, Oklahoma.

ENGINEER or thoroughly experienced oil man wanted capable of doing market research work in both drilling and refining division of oil business. Excellent future. Box D-232, The Oil and Gas Journal, Tulsa, Oklahoma.

SECONDARY RECOVERY ENGINEER Graduate Engineer. Three years field experience in waterflooding. Locate in Eastern Kansas. Salary open. Reply Box D-201, The Oil and Gas Journal, Tulsa, Oklahoma, giving age, education, experience, and salary desired.

REFINERY ENGINEERS

An American oil company operating in South America has openings for qualified graduate engineers:

EQUIPMENT INSPECTORS

Mechanical Engineers with 3-6 years in refinery with substantial equipment inspection experience. Will arrange and conduct inspections, request equipment renewals due to corrosion, failure or defectiveness in conformance with accepted safety codes. Will conduct tests of equipment, study causes and prevention of corrosion and failure of metals.

STAFF ENGINEERS

Electrical and Mechanical Engineers with 3-5 years oil refinery experience. Must be familiar with design and construction of oil refinery process equipment, electric power plants and related projects. Field experience necessary.

Write us telling of your age, marital status, education and detailed experience resume. Your letter will be held strictly confidential.

Box 308-R

Radio City Station

New York 19, N. Y.

HELP WANTED

FOR large company operating throughout Mid-Continent and Rocky Mountain states. Contract man with land experience and knowledge of operations. Excellent opportunity. Please state education and experience. Inquiries confidential. Box D-167, The Oil and Gas Journal, Tulsa, Oklahoma.

PETROLEUM SERVICE ENGINEER

Manufacturer of refinery processing materials has an opening for a Petroleum Chemist or Engineer for technical service to the petroleum industry.

The position will entail considerable traveling, primarily in the Gulf Coast area, doing field work with local representatives assisting them with their sales and product application in oil refineries.

Applicants must be 30 to 40 years of age, know chemical and mechanical processes and equipment and have experience in operating or refinery engineering.

Reply giving full details of education, experience and personal status to

F. B. JOHNSTON
Box O & G J. 1; 117 Liberty St.
New York 6, N. Y.

SITUATIONS WANTED

REFINERY Superintendent: 35, desires change. Fifteen years experience crude distillation, thermal cracking and treating. Would consider shift foreman or stillman job with aggressive company. References available. Box D-205, The Oil and Gas Journal, Tulsa, Oklahoma.

ATTENTION: Well established oil well drilling contractor desires to manage and supervise: Individuals', groups', small or medium-sized oil companies' drilling, production and operating problems in Central and Western Texas, and New Mexico. Personal interview by appointment is desired. Makin Drilling Company, Box No. 131, Ph. No. 131, Hobbs, New Mexico.

MICROPALEONTOLOGIST - GEOLOGIST, B.A., M.A., four years exploration and development experience in Ecuador, Peru, with major oil company, special interest paleo-stratigraphy; for foreign or domestic service. Excellent recommendations. Box D-196, The Oil and Gas Journal, Tulsa, Oklahoma.

LANDMAN-SCOUT, six years; accounting four years, all for independent operator, desires connection. Good background and training, married, steady and reliable, references. Write Box D-207, The Oil and Gas Journal, Tulsa, Oklahoma.

GEOLOGIST: Fourteen years of varied experience with major company. Desires position with independent concern. Box D-229, The Oil and Gas Journal, Tulsa, Oklahoma.

CANADIAN Chartered Accountant, 25, proven ability, top accounting degree, 7 years public accounting experience in Canada and U. S. Desires position with oil company with possibility of locating in Canada. Box D-230, The Oil and Gas Journal, Tulsa, Oklahoma.

WELL known oil field supply company closing Tulsa office, local manager desires connection as Manufacturer's Representative in Tulsa. Familiar with drilling, production, refining sales. Have sold Texas, Gulf Coast, and Oklahoma. Will travel. Box D-214, The Oil and Gas Journal, Tulsa, Oklahoma.

SECRETARY: Capable, intelligent, seeks position Washington or elsewhere with oil or oil equipment company. Three years' experience major company; familiarity U. S. Government procedures. Excellent references. Box D-224, The Oil and Gas Journal, Tulsa, Oklahoma.

SITUATIONS WANTED

GEOLOGIST, 25, married, desires job with progressive independent in Mid-Continent or Rockies. Now with major company in West Texas. Box D-227, The Oil and Gas Journal, Tulsa, Oklahoma.

LEASEMAN: Experienced lease buyer desires temporary or permanent leasing and curative work. Location unimportant. Box D-212, The Oil and Gas Journal, Tulsa, Oklahoma.

LADY with extensive land, lease and legal experience desires either secretarial or office management with an independent. P.O. Box 2273, Casper, Wyoming.

LEASE AND DRILLING BLOCKS

COCHISE Co. Ariz., Drilling Block; Sulphur Sprgs. Valley, 8000 acres for 4000 ft test. Chas. Baldwin, Box 1107, Goodyear Ariz.

MY ASSOCIATES and I will buy producing oil or gas properties. What have you? Brokers cooperate. Moss, 7733 Reading Road, Cincinnati 16, Ohio.

LEASES ROYALTIES

PRODUCING OR NONPRODUCING

Texas, New Mexico, Oklahoma, Louisiana and Illinois

Inquiries Invited

B. D. BUCKLEY
60 Broadway Drive, Clayton (5), St. Louis, Missouri

NORTH DAKOTA MINERALS

Bought direct for you on purchase order. I am thoroughly familiar with this play. Wire, call or write

JOHN ALLEN
808 Clarence Parker Hotel
Minot, North Dakota

(Member National Oil Scouts and Landmen Association. References exchanged.)

IN EXCHANGE

For interest in oil leases to be produced, we will furnish brand new oil well casing, tubing and line pipe. Advise full details of the lease or leases you contemplate producing.

Box D-226

The Oil and Gas Journal, Tulsa, Okla.

Donald Bolls
NORTH DAKOTA office
Clarence Parker Hotel,
Minot, North Dakota

Minerals Participating—Oil & Gas Leases available for immediate delivery in Heart of Williston Basin Play.

Have experienced Buyers in field. Former Major Company District Landman.

Major & Independent Company Leasing Experience.

LEASE AND DRILLING BLOCKS

FOR SALE: Oil and Gas Leases and drilling propositions in shallow territory of Allen, Simpson, and Warren Counties, Kentucky. W. P. Harley, Bowling Green, Ky.

WILL BUY gas or oil production, large or small. Prefer properties with some undeveloped acreage. Might consider drilling deals. Box D-172, The Oil and Gas Journal, Tulsa, Okla.

WILL SELL ½ interest undivided or checkerboard 10,000 acres of leases and drill 4 wells. Four separate structures Northwest Colorado and Southern Wyoming adjoining major oil company holdings. Two structures proven for shallow gas. One structure within four miles of production and near recent Oak Creek, Colorado, wildcat discovery. Major oil company will join in drilling. Other structure near 2nd largest oil field in Colorado. Price $10.00 per acre —$100,000.00. S. Marvin James, K-bar-T Ranch, Meeker, Colorado. Phone Meeker 4.

260 ACRES of oil prospects for lease: Glass and lime rock, adjoining the Dunlap lease of Oklahoma City. Dora McKinney, Marble City, Oklahoma.

STEPHENS County, Texas, acreage for development between Caddo and Lake Sand production. Also Ellenberger production near. John Rush, Box 271, Waco, Texas.

ROYALTIES

DEEDED ROYALTIES
San Juan Basin & Permian Basin. Write Harry S. Wright, Wright Bldg., Farmington, New Mexico.

ROYALTIES IN HOT AREAS!
Recent strikes have focused attention on Montana's deeper oil zones and major companies are moving fast, drilling and leasing. We buy direct in the field, sell direct to our customers. Write LANDOWNERS ROYALTIES COMPANY, Box 1225, Great Falls, Montana.

CASH MARKET for PRODUCING ROYALTIES
ROBERT L. KINKAID
World Bldg. Tulsa, Oklahoma

WILL buy small producing oil royalties. Send description and oil run records. No brokers. Okmulgee Royalty Co., 1321 Natl City Bldg., Dallas, Texas.

WE will buy producing or non-producing oil royalties. Standard Security Company, 595 Madison Avenue, New York 22, N. Y.

BUSINESS OPPORTUNITIES

MOTION PICTURE producer, young, progressive, HONEST, offers opportunity to financial backer as associate. Plans for vital company to make highly profitable films on small investment. P. O. Box 136, Hollywood 28, Calif.

ATTENTION UTILITIES

Now organizing to furnish gas service to various communities. We will supply

BRAND NEW STEEL PIPE and TUBING

for stock in your company. Give us full details proposed distribution system and financial setup.

Box D-225

The Oil and Gas Journal, Tulsa, Okla.

FOR SALE

TRUCK LETTERING AND TRADEMARK DECALS made for your trucks and equipment. Easy to apply, uniform, distinctive, economical for small or large needs. Write for catalog. MATHEWS COMPANY, 827 S Harvey, Oak Park, Illinois.

MERCURY
Pure grade, 0000% non volatile residues. Each lot tested for purity before packaging. Packed in 1, 5 & 10 lb. glass containers. For prices & terms address H M Co., P. O. Box 6012, Dept. O, Kansas City, Mo.

PATENT ATTORNEYS

PATENT Practice before U. S. Patent Office. Validity and Infringement Investigations and Opinions. Booklet and form "Evidence of Conception" forwarded upon request. Lancaster, Allwine & Rommell, Registered Patent Attorneys, Suite 418, 815-15th Street, N.W., Washington 5, D. C.

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BURKHART LEGAL BLANKS since 1906 Oil-Gas (all states), Business, Real Estate. Legal Forms, Leases, Revised With Government Regulations, Commercial Printing, Catalog and Samples on request. Burkhart Printing & Stationery Company, 115 South Cincinnati, Tulsa 3, Oklahoma.

CANADIAN FIELDS

Redwater Extension May Be New Field Discovery

CALGARY.—Canada's largest major oil field, Redwater, located about 35 miles northeast of Edmonton, has an indicated 3½-mile southeast extension. The important extension well, or discovery of a new oil pool as the case may be, is Imperial-Simmons 1, located in LSD 1, 25-56-21w4, about 4½ miles northwest of the town of Bruderheim. Owner of the well, Imperial Oil, Ltd., has run to date two drill-stem tests in top of the D3 zone that was topped 190 ft. above the Redwater water line. Tests were not conclusive, and coring and testing is being continued, with current depth 3,112 ft.

First drill-stem test gave a slight gas blow, and showed oil. Due to mechanical difficulties, a satisfactory test was not obtained. Second drill-stem test at the Simmons wildcat did not flow oil; however, oil flowed as the pipe was being pulled. The gravity and nature of the oil have not yet been determined, but the oil appears similar to that of Redwater. Further testing will be necessary before the full extent of the oil showing can be determined.

Continental Oil Co.'s Canadian operating unit, Hudson's Bay Oil & Gas Co., has discovered crude oil of gravity between 19° and 20° A.P.I. at its H. B. Winnfred wildcat in southeast Alberta. Whether it will be developed into a small commercial producer or not will be determined by further testing. The Winnifred well is located in LSD 15, 3-10-10w4, about 6 miles southeast of Bow Island gas field and around 40 miles east of Taber, where California-Standard Co. has two small Lower Cretaceous sand oil fields.

Crew drilled the well to 3,245 ft., set 7-in. casing at 3,242 ft., gun perforated opposite the Lower Cretaceous sand from 3,182-92 ft. with 40 shots, and then commenced running production tests. First 12-hour swab runs recovered 51 bbl. of oil and 34 bbl. of salt water. Further swabbing gave results of around 50 bbl. of oil and 70 bbl. of water daily. Attempts are now being made to squeeze cement off the water, and then perforate the sands at a higher level.

The British American Oil Co.-Union Oil Co. of California-Hudson's Bay Oil & Gas Co. team has made a natural-gas discovery in the Viking and Lower Cretaceous sands at the St. Paul 1 wildcat, LSD 5, 34-56-9w4, about 90 miles northeast of Edmonton.

New Pacalta-Whitemud No. 3 ,LSD 16, 15-51-25w4, about ¼ mile north of New Pacalta 1 oil success, and 200 ft. south and 180 ft. west of the No. 2 abandonment, has received a substantial pipe recovery of crude oil during Lower Cretaceous drill-stem test. First drill-stem test at 4,079 ft. gave a flow of gas throughout test with a pipe recovery of 490 ft. of clean oil. Second test at 4,084 ft. flowed natural gas at the rate of 300,000 cu. ft. daily and showed a pipe recovery of 890 ft. of oil. Crew plans to core on another 5 ft. prior to running production string of casing.

Unsuccessful wildcats.—B-H-S 2 Flatbush, LSD 1, 3-66-1w5, TD 3,639 ft.; Pan Western et al 1 Kavanagh, LSD 16, 16-48-24w4, TD 5,628 ft.; Oyen Wheat 1 King, LSD 1, 3-27-5w4, TD 3,741 ft.; Petromine 1 Saddle Lake, LSD 9, 19-59-10w4, TD 3,202 ft. Imperial 1 Willingdon, LSD 14, 14-58-15w4, TD 6,533½ ft., capped as a potential gas well.

Illinois

(Continued from page 380)

a drill-stem test of McClosky lime at 3,293-3,308 ft. Gas showed within 5 minutes after the testing tool was opened and oil was at the surface within 13 minutes. On the basis of the test, the well is expected to make one of the best producers yet completed in the area. Casing was cemented at 3,295 ft.

ILLINOIS SUCCESSFUL WILDCAT

Edgar County: National Associated Petroleum Co. and Continental Oil Co. 1 Luken-Mason-Elliott Comm., SE SE NE 2-12n-11w, IP 115 bbl., McClosky 978-86 ft., TD 986 ft. (Extension Eldridge pool.)

ILLINOIS WILDCAT FAILURES

Clark County: M. M. Stickler et al 1 Fitzgerald, SW NW SE 10-11n-13w, dry, TD 425 ft.

Coles County: J. C. Pulliam 1 Cashat, SE NE SE 24-12n-8e, dry, TD 620 ft.

Edgar County: E. P. Spicer 1 Meyers, NE SW SW 25-14n-11w, dry, TD 1,158 ft.

John Carlson 1 Wm. Roll, NE NW SE 7-14n-13w, dry, TD 791 ft.

J. W. Rudy 1 Sizemore, SE SW SE 16-13n-11w, dry, TD 2,051 ft.

C. A. Baldwin 1 Parrish, NW NW NE 2-12n-11w, dry, TD 1,107 ft.

Jasper County: Robinson & Puckett 1 Robinson, NE NE NE 19-7n-14w, dry, TD 2,398 ft.

Madison County: Campbell & DeLee 1 Danderman, NE SE SE 28-5n-6W, dry, TD 1,840 ft.

Marion County: Ben J. Taylor 1 Hallaire, SE NE SE 27-1n-4e, dry, TD 3,003 ft.

Moultrie County: Sohio Petroleum Co. 1 Schable, SW SE NW 15-15n-6e, dry, TD 3,002 ft.

Wabash County: Illinois Mid-Continent Co. 1 Hamilton, SE NW SE 4-1s-13w, dry, TD 2,758 ft.

Ryan & Sharp 1 Nash, SW SW SW 26-2s-13w, dry, TD 2,797 ft.

Washington County: Wm. H. Krohn 1 Jack Estate, SE NE SE 22-2s-2w, dry, TD 1,692 ft.

Wayne County: National Associated Petroleum Co. 1 Lee et al, SE NE NW 33-1n-5e, dry, TD 3,030 ft.

White County: Inland Producers 1 Rankins, SE NW NW 13-4s-10e, dry, TD 3,190 ft.

Permian Basin

(Continued from page 368)

ft., Delaware sand 2,850 ft., elevation 3,002 ft.

Lea County: Humble Oil & Refining Co. 1-X State, NW NE 31-11s-35e, dry, TD 13,228 ft., San Andres 4,160 ft., Abo 7,840 ft., Pennsylvanian 10,565 ft., Mississippian 12,138 ft., Devonian 13,138 ft., elevation 4,154 ft.

TEXAS PANHANDLE (DISTRICT 10) SUCCESSFUL WILDCAT

Roberts County: Sinclair Oil & Gas Co. 2 Lips, Tract B, SW NE 157-13-T&NG, 1 mi. NW 1 Lips, TD 9,137 ft., PB 8,780 ft., jet-perforated 216 shots in the Morrow section of Pennsylvanian 8,110-65 ft., gaged 12,777,000 cu. ft. of gas daily through tubing, flowing pressure 1,800 psi., shut-in pressure 2,100 psi., open flow estimate 41,000,000 cu. ft. of gas daily, distillate yield, if any, not reported.

TEXAS PANHANDLE (DISTRICT 10) WILDCAT FAILURE

Hall County: T. F. Vanderlaan 1 Chaudion, Sec. 32, J. Poitevent Sur., 5 mi. W Estelline, dry, TD 5,243 ft., elevation 1,832 ft., formation tops not yet released.

CALENDAR

October

American Institute of Mining and Metallurgical Engineers, Petroleum Branch, fall meeting, Plaza Hotel, San Antonio, October 5-7.

California Natural Gasoline Association, Ambassador Hotel, Los Angeles, October 7.

American Society for Testing Materials, Pacific area meeting, Hotel Fairmont, San Francisco, October 10.

American Association of Petroleum Geologists, regional meeting, Buena Vista Hotel, Biloxi, Miss., October 12-14.

Symposium on Instrumentation for the Process Industries, fourth annual session, School of Engineering, Texas A. & M. College, College Station, Tex., October 12-14.

Texas Mid-Continent Oil and Gas Association, annual meeting, Rice Hotel, Houston, October 13-14.

Natural Gasoline Association of America, Southern Regional Meeting, Tyler Texas, October 14.

Oil Progress Week, October 16-22.

American Gas Association, annual convention, Chicago, October 17-20.

American Institute of Mining and Metallurgical Engineers, Petroleum Branch, fall meeting, Elk's Club, Los Angeles, October 20-21.

Western Petroleum Refiners Association, regional technical meeting on waste-disposal problems, Palmer House, Chicago, October 21.

American Institute of Chemical Engineers, South Texas Section, annual meeting, Hotel Galvez, Galveston, October 21.

National Safety Congress, Morrison Hotel, Chicago, October 24-28.

South Texas Geological Society, sixteenth annual meeting and field trip, San Antonio, October 28-30.

Independent Natural Gas Association of America, annual meeting, Baker Hotel, Dallas, October 31.

November

Pacific Industrial Conferences and Pacific Chemical Exposition, Civic Auditorium, San Francisco, November 1-5.

Society of Automotive Engineers: diesel-engine meeting, Chase Hotel, St. Louis, November 1-2; fuels and lubricants meeting, Chase Hotel, St. Louis, November 3-4.

American Petroleum Institute, annual meeting, Stevens Hotel, Chicago, November 7-10.

Rocky Mountain Oil and Gas Association, annual meeting, Cosmopolitan Hotel, Denver, November 17-19.

American Association of Petroleum Geologists, Society of Exploration Geophysicists, and Society of Economic Paleontologists and Mineralogists, Pacific Coast joint regional meeting, Ambassador Hotel, Los Angeles, November 17-18.

Petroleum Electric Power Association, annual conference, Hotel Beaumont, Beaumont, Tex., November 17-18.

Society of Exploration Geophysicists, regional exploration meeting, Adolphus Hotel, Dallas, November 17-18.

Exposition of Chemical Industries, Grand Central Palace, New York, November 20-December 3.

American Society of Mechanical Engineers, annual meeting, Hotel Statler, New York, November 27-December 2.

NOMADS

Houston Nomads, second Monday of each month, Ye Ole College Inn, Houston.

Los Angeles Nomads, second Wednesday of each month, Jonathan Club.

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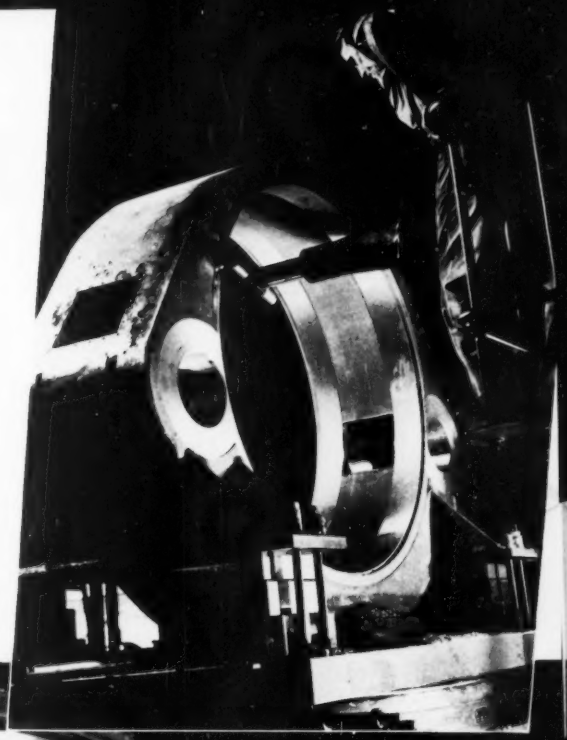

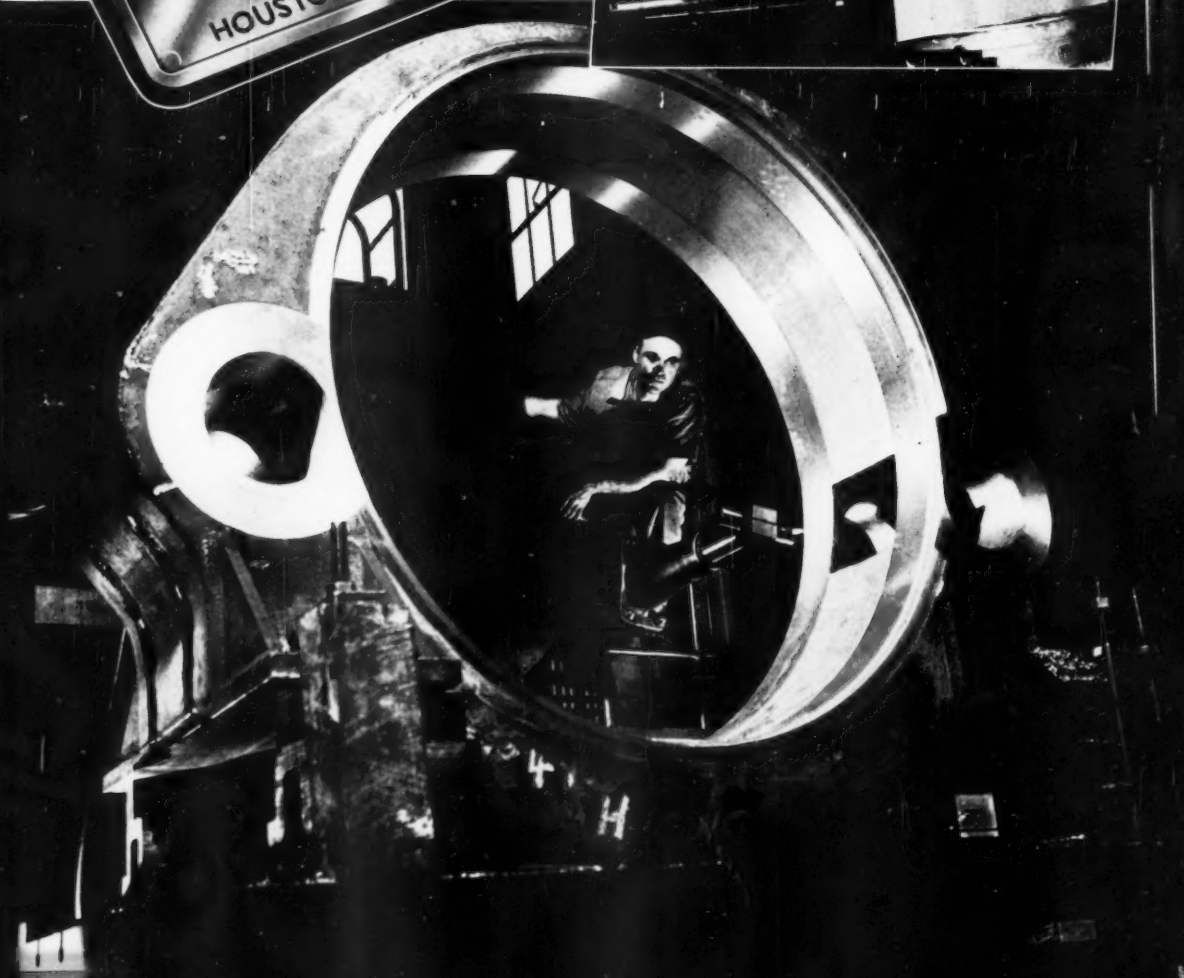

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